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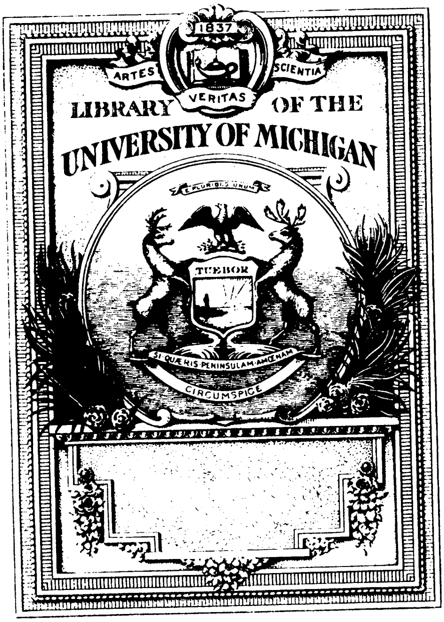

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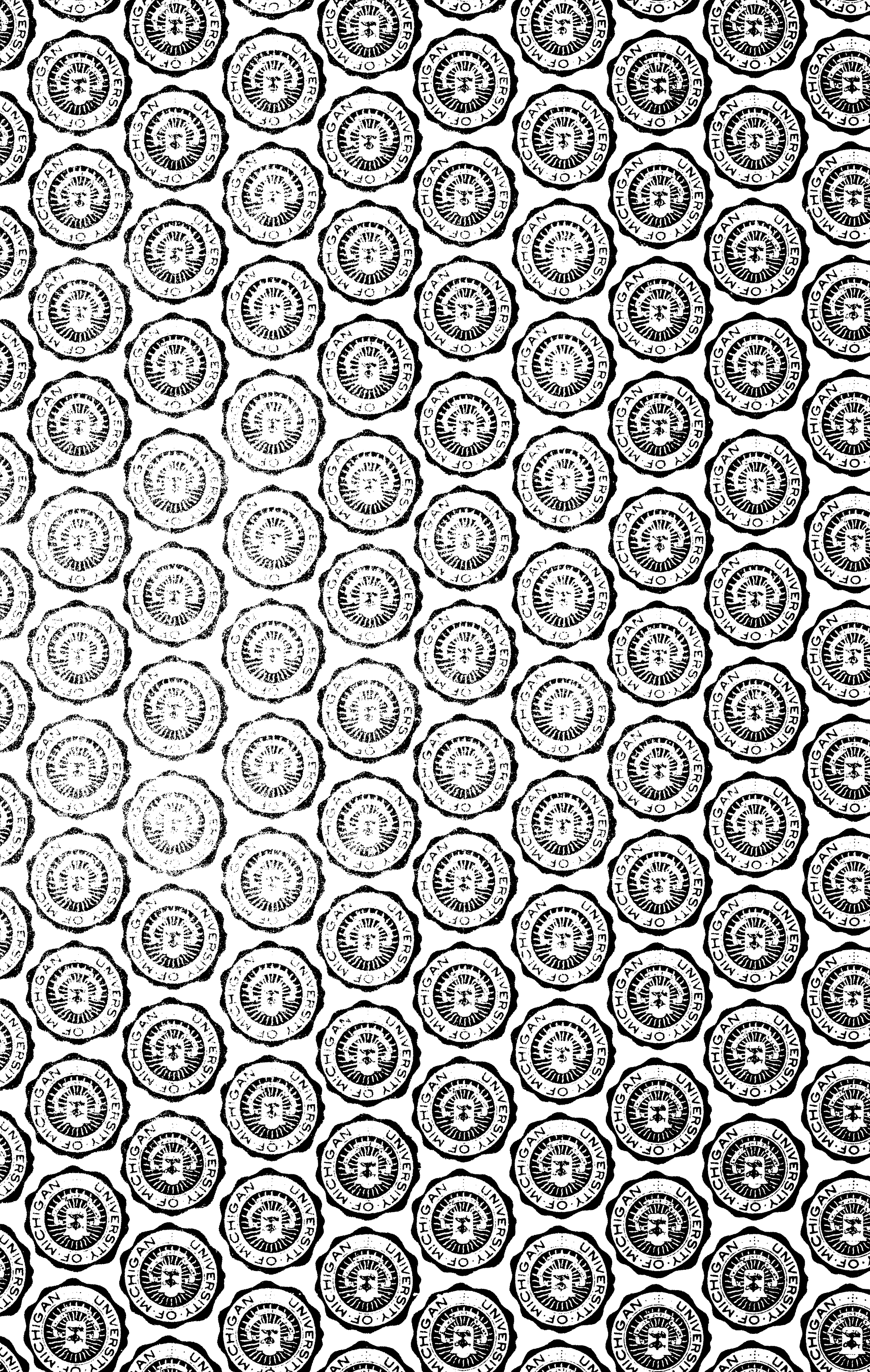
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VOLUME 34

SEPTEMBER TO DECEMBER, 1927
WITH 73 PLATES AND 31 TEXT FIGURES

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THE PHILIPPINE
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VOL. 34 SEPTEMBER, 1927 No. 1

THE PHILIPPINE BUTTERFLY FISHES AND THEIR ALLIES

By ALBERT W. HERRE and HERACLIO R. MONTALBAN
Of the Division of Fisheries, Bureau of Science, Manila

TWENTY-FOUR PLATES

Series CHÆTODONTIFORMES

We include here all those fishes belonging to the suborder Squamipinnes which have a deep, greatly compressed, suborbicular, or rhomboidal body, covered with finely ctenoid or smooth scales which extend upon the soft dorsal, anal, and caudal, and often upon the spinous part of the dorsal, so that the distinction between body and vertical fins is more or less effaced; the mouth is small, terminal, with lateral cleft, toothless palate and vomer, except in *Platax,* which may have a few vomerine teeth; the maxillaries have villiform or bristlelike teeth (trilobed in *Platax*), with neither incisors, canines, nor molars; in most, if not in all, the mesethmoid is depressed, a character typical of the chætodonts; the dorsal fin consists of an undivided spinous and soft portion, usually of nearly equal development; the anal has three or four spines, the rayed portion similar to the soft dorsal; the lower rays of the pectoral fin are branched, not enlarged; the thoracic ventrals have one spine and five rays; the stomach cæcal, the pyloric appendages few to many, the intestines much convoluted; the air bladder may be constricted or with horns; the lateral line is continuous, but may be incomplete; vertebræ 10 + 14 or 10 + 13; pseudobranchiæ well developed.

In the Chætodontidæ and Scatophagidæ the young are very different from the adults and were first described as the genus *Tholichthys;* in them the bones of the head and shoulder girdle form enormously enlarged plates which may entirely cover the head and hide the dorsal and ventral fins; as the young develop the plates are absorbed, but those attached to the shoulder girdle remain until the larva assumes the shape of the adult. The very young stages of the other groups are not known.

The members of this group are typical fishes of the coral reef, in the coves and depths of which they swarm, and they also love to dwell along precipitous rocky or lava coasts. Most of the species have long been known, the beauty and singularity of their colors being unsurpassed and attracting the attention of man from the earliest times. Most of them are small, and as they do not occur in vast schools comparatively few are of any importance as food. The flesh of some of the holacanthids has a delicious flavor, so that they are much prized locally.

All of our species are exclusively marine, with the exception of *Scatophagus*.

In this paper the length does not include the caudal fin, unless so stated.

Under the Chætodontiformes we include five families of fishes as follows:

a^1. First dorsal spine recumbent and directed forward.
  b^1. Dorsal spines 8 or 9, the third longest and flexible; anal spines 3; pectoral elongate, falciform.......... **Drepanidæ.**
  b^2. Dorsal spines 10 or 11; pectoral short, not falciform.
    c^1. Fifth dorsal spine longest, not filiform, 1.2 to 1.6 times in head; anal spines 4.......... **Scatophagidæ.**
    c^2. Fourth, fifth, and sixth dorsal spines much longer than head, with elongate threadlike tips; anal spines 3.......... **Ephippidæ.**
a^2. First dorsal spine erect, not directed forward.
    d^1. Dorsal and anal moderate, not greatly elevated; ventrals not remarkably elongate, their origin behind that of pectorals; dorsals continuous, spines 6 to 16, rays 15 to 30; anal spines 3 or 4, rays 15 to 23, teeth in several rows, simple, rarely tricuspid. **Chætodontidæ.**
    d^2. Both dorsal and anal greatly elevated; ventrals very noticeably elongate, their origin before that of pectorals; dorsal spines 3 to 7, nearly hidden, rays 28 to 54; anal spines 3, rays 22 to 29; outer row of teeth tricuspid.......... **Platacidæ.**

DREPANIDÆ

Body very deep, much compressed, greatly elevated at origin of dorsal, covered with medium-sized scales; pectoral falcate, very long, reaching or nearly reaching base of caudal. First dorsal spine recumbent and directed forward; dorsal spines 8 or 9, folding into a basal groove, the membrane deeply notched between the spines; head much deeper than long, with very steep profile and short snout; preopercle smooth; palate without teeth; air bladder prolonged posteriorly into two horns; pyloric appendages few; branchiostegals 6; pseudobranchiæ present.

One genus with two species inhabiting the Indian Ocean and seas of the Indo-Australian Archipelago.

Genus DREPANE Cuvier and Valenciennes

Drepane CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 97.

The characters of the genus are sufficiently indicated under the family.

Key to the species of Drepane.

*a*¹. Body with 4 to 11 vertical rows of black spots; air bladder with 2 pairs of lateral cæca, the posterior ones very long........ **D. punctata.**

*a*². Body with 4 to 9 vertical black bands from back to lateral line and middle of body; air bladder with about 15 pairs of much-branched lateral cæca .... **D. longimana.**

DREPANE PUNCTATA (Linnæus). Plate 1, fig. 1.

Chætodon punctatus LINNÆUS, Syst. Nat. ed. 10 1 (1758) 273.

Drepane punctata CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 99, pl. 179; GÜNTHER, Cat. Fishes 2 (1860) 62, B; Fische der Südsee 1 (1873) 55; DAY, Fishes of India (1878) 116, pl. 29, fig. 5, text pro parte; JORDAN and SEALE, Bull. Bur. Fisheries 26 (1906) 33; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 268; LELE, Journ. Asiatic Soc. Bengal N. S. 20 (1924) (1925) 285, pl. 12, fig. 1, and 6 text figs.

Harpochirus punctatus CANTOR, Cat. Malayan Fishes, Journ. Roy. Asiatic Soc. Bengal 18 (1849) 162; BLEEKER, Atlas Ichth. 9 (1878) 19, pl. 365, fig. 4, text and synonymy pro parte.

Local names.—Bicol, *riring;* Tagalog, *mayang;* Visayan, *bayang.*

Dorsal IX, 21; anal III, 18; there are 46 to 48 scales in a lateral series, 15 to 18 between the lateral line and the origin of dorsal, 32 or 33 between the lateral line and the origin of anal.

The exceedingly deep body much compressed and strongly elevated, the deepest part vertically from the base of the first three dorsal spines contained from 1.1 to 1.2 times in the length; the dorsal and ventral profiles more or less angular at origin of dorsal and origin of anal, between which points the depth of the body is slightly less than its length in large examples, and a little greater in small ones; anterior half of dorsal profile steep and a little convex and that of ventral profile before anal fin very oblique and almost straight; head much deeper than long, its upper profile exceedingly steep and much more elevated than ventral, length 2.6 to 2.9 times in that of body; the short caudal peduncle very deep and strongly compressed, its least depth 6 to 7.2 times in length of body; the interorbital space is moderately convex and bulges up slightly on the upper profile of head, its width 3.5 to 4.1 times in head; the rounded eye very much elevated and anterior, its diameter 3.1 to 3.5 times in head and slightly shorter than width of preorbital or length of maxillary, which is contained from 2.8 to 3.3 times; the mouth small and horizontal, the jaws even, the teeth pointed and slender, crowded together, no teeth on vomer and palate, the maxillary extending to below front third of orbit; the two nostrils in front of each eye rounded and very well separated, the front one a little more superior than the other and each having a low fleshy rim; only the angle and lower limb of preopercle serrated.

The scales on side of body moderate in size, those on head, vertical fins, and caudal becoming very small; the lateral line is concurrent with the form of the back and extends to base of caudal fin; the dorsal fin deeply emarginate, the first spine concealed, recumbent, pointed forward, the third spine highest, 1.2 to 1.6 times in head, the last one about as long as third anal, which is 2.1 to 3 times in head; the soft dorsal rounded, highest along the middle; the posterior margin of anal nearly vertical; last rays very short; the anal and caudal both a little convex centrally; the elongate and falcate pectoral nearly twice the head and from 1.2 to 1.6 times in the length of body, reaching to or nearly to root of caudal fin; the first ray of ventral elongate; the spine is 1.5 to 2.5 times in head and extends to or beyond anal opening.

In young examples the superior rim of orbit and the upper edge of occipital process serrated, while in still younger ones in addition to the above there is a roughened ridge connecting the upper rim of orbit with the lateral line.

The rather small air bladder has two very short anterior horns and two long, tubular posterior horns; at each anterior angle are two cæca, the posterior of which sends out lateral flattened branches extending halfway or nearly the whole length of the bladder; the cæca and branches are held together by a soft transparent connective tissue, so that they look like a thin ribbon lying between the bladder and the body wall; there is also a pair of very short cæca between the posterior horns.

The intestine is twisted into two knots in addition to its loops; pyloric cæca 2.

This strangely shaped fish is bright silvery in life, with beautiful purple reflections on sides, over which is a golden luster; on each side of body are four to eleven vertical series of black spots on the dorsal half, confluent in the young; the edges of the fins grayish; an indistinct band of similar color along middle of dorsal.

In alcohol the ground color varies from yellowish to yellowish brown, with silvery reflections; the spots on body purplish brown; the fins grayish on their outward portions.

In addition to many living and fresh specimens in the field, we have examined in the Bureau of Science collection twenty-one Philippine examples, 20 to 285 millimeters long, coming from the following localities: Manila Bay; Malabon, Rizal; San Miguel Bay, Camarines Sur; Tacligan and Mangarin, Mindoro; Iloilo, Panay Island; Bantayan Island; Catbalogan, Samar, Misamis, Misamis; and Davao, Mindanao. We have compared these specimens with seven others, 29 to 108 millimeters long, from Hoihow, Hainan; Hongkong; and Sandakan, Borneo.

The first Philippine record of this species is that of Günther, of a fine specimen labeled "Philippine Islands;" it has been also reported previously by Jordan and Seale from Cavite, and by Jordan and Richardson from Lubang and Manila. It occurs from the Red Sea and east coast of Africa, through the seas of India and the Indian Archipelago, to Samoa, northward to China and southward to the northwestern coast of Australia. It reaches a length of about 460 millimeters, and is esteemed highly as food, though the flesh is dry. In the Philippines it is usually caught in *baclad.*

DREPANE LONGIMANA (Bloch and Schneider). Plate 1, fig. 2.

Chætodon longimana BLOCH and SCHNEIDER (1801) 229.

Drepane longimana CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 101; LELE, Journ. Asiatic Soc. Bengal N. S. 20 (1924) (1925) 286, pl. 12, fig. 2, and 6 text figs.

Drepane punctata GÜNTHER, Cat. Fishes 2 (1860) 62, *A* and *C;* DAY, Fishes of India (1878) 116, pro parte.

Harpochirus longimana CANTOR, Journ. Roy. Asiatic Soc. Bengal 18 (1849) 163; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 (1922) 54.

Cryptosmilia luna COPE, Trans. Am. Phil. Soc. 13 (1869) 401.

Drepane octofasciata OSORIO, Journ. Sci. Acad. Lisboa II 2 (1892) 207.

Dorsal IX, 21; anal III, 18; there are 48 scales in a lateral series, 15 between the lateral line and the origin of dorsal, 33 between the lateral line and the origin of anal.

The deepest portion of the much-compressed and strongly elevated body is vertically at the base of the first three dorsal spines and contained 1.2 times in the length; the upper and lower profiles more or less angular at origins of vertical fins, between which points the depth of body is nearly equal to its length; the anterior half of the dorsal profile steep and slightly convex, that of the ventral very oblique and almost straight; the head much deeper than long, its length 2.7 to 3 times in length of body, and its upper profile more strongly elevated than the ventral and almost vertical anteriorly; the least depth of the short, strongly compressed caudal peduncle 6 to 6.7 times in length of body; the moderately convex interorbital bulges up slightly on upper profile of head, its least width 3.2 to 3.5 times in head and equal to the diameter of the rounded, much-elevated eye; the snout is almost vertical above, 2.1 to 2.5 times in head, and exceeds the maxillary which is contained 2.8 to 2.9 times; the least width of the preorbital nearly equal to length of maxillary and 2.8 to 3.2 times in length of head; the mouth rather small and nearly horizontal, the jaws even, the teeth pointed and slender, crowded together; teeth absent on vomer and palate; the maxillary extends to a little past vertical from anterior edge of eye; two small rounded nostrils in front of each eye, the anterior one a little more superior than the other and both having a low fleshy rim; the preopercle serrated at its angle and lower edge.

Moderate scales cover each side of body, becoming very small on head, vertical fins, and caudal; the lateral line follows the form of the back and extends to base of caudal fin, arching most strongly below base of middle dorsal spines; in front of this arch the lateral line very slightly concave or almost straight; the fourth spine of the deeply emarginate dorsal highest, being 1.6 to 1.8 times in head, the last one 2.9 to 3.2 times in head and much lower than ventral spine which is contained 1.8 to 2.2 times; the rounded soft dorsal highest at middle; the anal rays and the caudal a little convex along middle; the elongate and falcate pectoral is nearly twice the length of head and reaches to caudal peduncle; the ventral fin extends to base of anterior anal rays, its spine 2.8 to 2.9 times in length of head.

The large air bladder has two short anterior and two long tubular posterior horns, the bladder larger and the posterior horns longer than in *D. punctata;* on each side of bladder are about fifteen intricately branched cæca, beginning at its top and extending down upon the posterior horns; the cæca and branches are encased in soft transparent connective tissue and form a triangular ridge on each side, the ridges fitting into special pockets between the ribs; there are three pairs of cæca on the inner margins of the posterior horns.

The intestine is looped as in *D. punctata,* but has no knots; pyloric cæca 3.

The color of this fish in life is bright silvery, with a beautiful purplish tinge on sides, over which is a golden luster; eight black transverse bands descending from back to middle of side, or some may stop at the lateral line.

In alcohol the ground color is yellowish brown, with silvery reflections; the bands on the sides blackish; all the fins are blackish on their outward portions.

The above description is taken from a specimen, 87 millimeters long, collected at Estancia, and one, 122 millimeters long, taken at Barotac Nuevo, Panay.

This species, which may have been recorded previously from the Philippines as *Drepane punctata,* occurs from the west and east coasts of Africa and the Red Sea, eastward to Australia.

SCATOPHAGIDÆ

A group of chætodontoid fishes with subrhomboid or somewhat quadrangular and strongly compressed body, covered with small, smooth ctenoid scales; snout moderate; two dorsals united basally, the spinous dorsal with 11 or 12 spines, the first recumbent and pointed forward, the rayed portion shorter than the spinous, with 16 to 19 rays; anal spines 4, rays 14 to 16; preopercle spineless, palate and vomer toothless; teeth tricuspid; air bladder simple; pyloric appendages rather numerous; branchiostegals 6; pseudobranchiæ present.

A small family of fishes confined to the Indian Ocean and Indo-Australian Archipelago, with but one genus and only two or three valid species.

Genus SCATOPHAGUS Cuvier and Valenciennes

Scatophagus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 103.

Scales very small, 90 to 130 in longitudinal series; spinous dorsal scaleless, the soft dorsal, anal, and caudal scaled; pectoral short, rounded; head scaled everywhere; maxillary not protractile.

Fishes of both fresh and salt water, the flesh of excellent flavor but not valued in some regions because of their feeding habits about inhabited places.

SCATOPHAGUS ARGUS (Boddaert). Plate 2, fig. 2; Plate 12, fig. 2.

Chætodon argus BODDAERT, Over den gevlakten klipvisch (1770); BLOCH, Ichtyologie 6 (1788) 63, pl. 204, fig. 1; BONNATERRE, Ichthyologie (1788) 86, pl. 94, fig. 386; GMELIN, Syst. Nat. ed. 13 (1788) 1248.

Scatophagus argus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 103; GÜNTHER, Cat. Fishes 2 (1860) 58; KNER, Reise Novara, Fische (1865) 106; PETERS, Monatsber. Akad. Wiss. Berlin (1868) 257; DAY, Fishes of India (1878) 114, pl. 29, fig. 3; MEYER, Ann., Soc. España Hist. Nat. 14 (1885) 18; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 246, fig. 8; WEBER, Fische Siboga Exped. (1913) 302, pl. 10, figs. 1–5.

Ephippus argus CUVIER, Règne Anim. ed. 1 2 (1817) 335; BLEEKER, Atlas Ichth. 9 (1879) 21, pl. 363, fig. 2; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 789; SMITH and SEALE, Proc. Biol. Soc. Wash. 19 (1906) 78; JORDAN and SEALE, Bull. Bur. Fisheries 26 (1906) 32; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1906) 97; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 268.

Chætodon pairatalis BUCHANAN HAMILTON, Fishes Ganges (1822) 122, 372, pl. 14, fig. 41.

Scatophagus ornatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 108, pl. 180; GÜNTHER, Cat. Fishes 2 (1860) 59; KNER, Reise Novara, Fische (1865) 272.

Chætodon atromaculatus BENNETT, Fishes Ceylon 18 (1834) pl. 18; very fine figure.

Common names.—Bicol, *bayang, kikiro;* Tagalog, *kitang;* Visayan, *akikiro, ngisi-ngisi;* Ilocano, *malaga.*

Dorsal XI, 16 to 18; anal IV, 14 or 15; there are 90 to 128 scales in a lateral series, 28 to 34 between the lateral line and the origin of dorsal, and 55 to 82 between the lateral line and the origin of anal.

The depth of the somewhat quadrangular and strongly compressed body contained from 1.5 to 1.7 times in the length, with the back more strongly elevated than the ventral outline; the head about as long as deep, 2.9 to 3.3 times in length of body, its upper profile slightly arched at interorbital space; the depth of the short, strongly compressed caudal peduncle 6.1 to 7.3 times in length of body; the strongly arched interorbital space rather wide, 2.4 to 2.7 times in head and a little wider than the bluntly rounded snout, which is contained from 2.7 to 3.2 times in head; the eye circular and rather small, a little closer to tip of snout than to posterior edge of preopercle, and about midway in depth of head, its diameter 3.3 to 4.3 times in head and longer than the short maxillary which is contained from 3.6 to 4.7 times; the width of preorbital at end of maxillary

5.6 to 6.7 times in length of head; the mouth small and horizontal with villiform teeth and equal jaws; the two nostrils in front of each eye rather well separated and about as far from each other as the posterior one is from orbit, the anterior one circular and having a fleshy rim which is highest behind, the other an almost ovoid opening with a low fleshy rim; the lower edge of preorbital serrated; none of the opercular bones serrated.

The scales on the sides are generally small, becoming very small to minute on head, vertical fins, and caudal; the moderately arched lateral line extends to base of caudal fin; the first dorsal spine recumbent and pointed forward; the fifth dorsal spine highest and contained from 1.2 to 1.6 times in head; the last one a little lower than fourth anal spine which is 1.9 to 2.6 times in head; the anterior dorsal and anal rays longest, the posterior ones very short so that the posterior margin of each fin is inclined diagonally forward; the caudal fin fan-shaped; the short, rounded pectoral is 1.7 to 2.2 times in head and extends beyond a vertical through anus; the outer ray of ventral is produced and reaches to origin of anal fin; the spine goes 1.5 to 1.9 times in length of head and ends behind anus.

In very young examples, 36 millimeters long or less, there is a bony ridge from upper rim of orbit across opercle to shoulder, where it ends in a spine.

In life the ground color varies from violet-brown to dark brown, becoming paler on belly and having a beautiful purplish gloss, so that the fish has the bright new look of a freshly minted coin; each side of body has a number of scattered blackish rounded spots which are more numerous along the back, and vary in number, size, and tint; more rarely the spots are greenish.

Young living specimens are ornately colored and very beautiful; the ground color is olive brown, with about five black transverse bands which disappear sooner or later, and with rounded black spots scattered over the upper half; the head and anterior part of body have two or three crossbands of yellow, orange, or orange red, and three spots of the same color along the back, one at origin of dorsal, a larger one below the junction of the spinous and soft dorsals, and one on top of caudal peduncle below soft dorsal; soft dorsal, anal, and caudal colorless; ventrals black.

In alcohol the ground color of the fish varies from purplish to dark yellowish brown, becoming paler below and with rounded blackish spots scattered on each side of body; the vertical fins, caudal, and ventral dark brown; the pectoral yellowish.

The foregoing account is based upon an examination of many living and fresh specimens in the field and seventy-eight alcoholic examples, varying from 9 to 196 millimeters in length. Fifty-five of them were collected at the following Philippine localities:

Buguey, Cagayan.
Vigan, Ilocos Sur.
Barrio Nalva, Luna, La Union.
Alaminos, Pangasinan.
Iba, Zambales.
Malabon, Rizal.
Manila.
Bicol River, Camarines Sur.
Pasig River.
Molawin Creek, Laguna de Bay.
Calapan, Mindoro.
Bacon, Sorsogon.
Catarman, Samar.
Bintoan, Busuanga Island.
Bantayan Island.
Iloilo, Panay.
Estancia, Panay.
Taytay, Palawan.
Inabanga, Bohol.
Cabalian, Leyte.
Agusan River.
Malabang and Davao, Mindanao.
Balabac Island.
Tubigan Island, Sulu Archipelago.

The rest of the specimens were collected at Sandakan, Borneo; Foochow, Fukien Province; Hoihow, Hainan; and Hongkong, on the coast of China. The two specimens, collected at Estancia February 23, 1925, are ripe females.

The dorsal, anal, and ventral spines are all strong and sharp, the latter especially being very stout; with its spines the kitang is able to inflict grievous wounds, so that it is much dreaded by fishermen, who do not like to handle it. This fish is common in both salt and fresh water, freely entering rivers and lakes and ascending streams for a considerable distance. Very young as well as mature specimens are found in fresh water, though it is not definitely known to breed there. It reaches a length of over 300 millimeters, and is much used as food, in spite of the fact that in many places it feeds largely on human excrement, as its scientific name indicates. Bennett, whose figure is the best published, says that it feeds principally on seaweed and he, as well as many others, highly commend the flavor of its flesh. It takes the hook freely, whether in fresh or in salt water, and is often caught in traps and fish corrals.

Seale and Bean described and figured a young specimen in the armored, or *Tholichthys,* stage characteristic of the chætodonts, and Weber has a beautiful series of figures showing the various phases of this stage. We have six specimens, taken from Pasig River, Manila, each 9 millimeters in length, which show the characteristic bony plate armor of the head and shoulder girdle very well. We have kept many living specimens under observation for over five years, and have watched the young go through all their transformations and color changes until they became adult.

This handsome fish has been reported from the Philippines previously as follows: By Peters, Quingoa River at Calumpit, and Bicol River, Luzon; by Meyer, Manila Bay and Cebu; by Seale and Bean, Zamboanga; by Jordan and Seale, Negros and Cavite; by Smith and Seale, Cotabato, Mindanao; by Evermann and Seale, Bacon, Sorsogon Province, and San Fabian, Pangasinan Province; by Jordan and Richardson, Manila and Iloilo.

It is widely distributed in the Philippines and is common throughout the East Indies; it ranges eastward in the Pacific to Tahiti, northward to the coast of China, and westward to the Andaman Islands, India, and Ceylon. In spite of the very considerable variation in scalation and other characters we can recognize but one species.

EPHIPPIDÆ

The members of this family have a much elevated, nearly circular, and laterally compressed body; the snout short, the upper profile parabolic; the dorsal has 9 or 10 spines, the first recumbent and directed forward, several of the others elongated, flexible, with threadlike tips all folding into a basal groove; membrane between the spines deeply cleft and a deep notch between dorsal spines and rays; anal spines 3; scales moderate to small, extending upon the soft dorsal, anal, and caudal, but not on the other fins; pectoral short; no teeth on palate; no spine on preopercle. The air bladder is bifurcate anteriorly and has two long horns posteriorly; pyloric appendages few. Branchiostegals 6; pseudobranchiæ present.

A small family of orbiculate fishes, with but one genus known; species few, occurring in the Atlantic and the East Indies.

Genus EPHIPPUS Cuvier

Ephippus CUVIER, Règne Anim. 2 (1817) 335.

The characters of the genus are indicated under the family.

EPHIPPUS ORBIS (Bloch). Plate 2, fig. 1.

Chætodon orbis BLOCH, Ichtyologie 6 (1788) 59, pl. 202, fig. 2.

Ephippus orbis CUVIER, Règne Anim. Poiss. ed. 2 2 (1829) 108; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 96; GUÉRIN, Icon. Règne Anim. Poiss. (1830–1844) pl. 22, fig. 2; GÜNTHER, Cat. Fishes 2 (1860) 62; DAY, Fishes of India (1878) 115, pl. 29, fig. 1; SEALE, Philip. Journ. Sci. § D 5 (1910) 282.

Ilarches orbis CANTOR, Cat. Malayan Fishes, Proc. Roy Asiatic Soc. Bengal 18 (1849) 100; BLEEKER, Atlas Ichthy. 9 (1878) 20, pl. 365, fig. 5.

Ephippus melanopus BLEEKER, Nat. Gen. Arch. Ned. Ind. 2 (1845) 520.

Dorsal X, 19; anal III, 15; there are 35 scales in a lateral series; 10 between the lateral line and the origin of dorsal, and 14 between the lateral line and the origin of anal.

The very deep and much compressed body nearly circular; the upper profile is much more elevated than the lower and rises abruptly from snout to origin of dorsal fin; the depth contained 1.3 times in length; the head much deeper than long, its length 3 to 3.1 times in that of body and its upper profile a little convex; the least depth of the short and strongly compressed caudal peduncle contained from 6.8 to 6.9 times in length of body; the large, rounded eye 2.2 to 2.5 times in head, and slightly anterior in length; the interorbital space markedly arched and moderate in width, being 2.6 to 3 times in head; the bluntly rounded snout nearly vertical and about equal to eye, 2.3 times in length of head in our specimens; the short maxillary extends to opposite anterior margin of orbit and is 3.2 to 3.3 times in head; the width of preorbital at end of maxillary nearly half an eye diameter, and 4.2 to 4.3 times in head; the mouth small and horizontal, the jaws even; the teeth slender and pointed, absent on palate; two small nostrils rather well separated from each other in front of each eye, the anterior one circular with a low fleshy rim and the other a vertical slit very close to the rim of the orbit; the preopercle distinctly serrated.

The scales moderate in size; those on top of head and neck, and on outer portions of vertical and caudal fins very small; the moderately arched lateral line extends to base of caudal fin; the fourth, fifth, and sixth dorsal spines elongated and filiform at their tips, each being much longer than head; the first spine is a recumbent one directed forward; the rayed dorsal highest along its middle and the soft anal on its anterior portion; the caudal fin produced along the middle, and somewhat emarginate above and below; the pectoral short and slightly more than half the length of head, not extending to above anus; the ventral terminates at base of anal spines, its outer ray filiform and its spine about as long as pectoral.

The color in alcohol yellowish silvery; on each side of body are bright silvery longitudinal stripes which run between the horizontal rows of scales; the membranous portions of the fins finely dotted with black.

The Bureau of Science collection contains no specimens taken in Philippine waters, though this species unquestionably occurs within the limits of the Archipelago. Our description is based upon two specimens, 104 millimeters in length, collected by Alvin Seale at Sandakan, Borneo. Any marine fish listed from British North Borneo must likewise occur in Philippine waters between Balabac and Sitankai, since all that region belongs to Borneo geographically.

Elsewhere this species is known from India, Ceylon, and the Andaman Islands, through the East Indies to the coast of China and Formosa.

CHÆTODONTIDÆ

BUTTERFLY FISHES

The characteristic family of the Squamipinnes, or scaly-finned fishes, is the Chætodontidæ, represented in the Philippines by nine genera. The compressed body varies from subrhomboid to nearly circular, and is covered with medium-sized to small scales; the mouth small, terminal, protractile; the jaw teeth bristle- or brushlike, often very long; no teeth on vomer or palatines; no incisors, canines, or molars; the lateral eyes of moderate size; the dorsal fin single, continuous, not notched, its rays sometimes greatly elongated and then more or less filamentous or hairlike; the dorsal and anal rays densely covered with small or very small scales; the anal is similar to the soft dorsal and may have 3 or 4 spines; the lateral line is concurrent with the dorsal outline, and may terminate at the posterior extremity of the soft dorsal or run to the base of the caudal, but it never extends upon the caudal fin; the ventrals are thoracic, I, 5; the caudal is usually truncate; branchiostegals 6 or 7; pseudobranchiæ very large; the gill membranes more or less attached to the isthmus; the gill rakers very small; an air bladder always present; vertebræ $10 + 14 = 24$, the anterior ones shortened; the insertion of the ribs inferior.

This family includes several genera of very active coral-reef fishes, mostly small, and nearly all of remarkable brilliance and beauty of color.

Key to the Philippine genera of the Chætodontidæ.

a^1. Snout elongate and tubular.
  b^1. Dorsal spines 9; scales moderate, 45 to 55 in lateral series.. **Chelmon.**
  b^2. Dorsal spines 12; scales small, 70 to 80 in lateral series.... **Forcipiger.**
a^2. Snout not elongate and tubular, but short or of medium length.
  c^1. Lateral line terminating before caudal peduncle.

d^1. Dorsal spines 6 or 7.. **Parachætodon.**
d^2. Dorsal spines 11 to 14.. **Chætodon.**
c^2. Lateral line extending to base of caudal fin.
e^1. No long stout spine at lower posterior angle of preopercle; preopercle smooth or nearly so.
f^1. Dorsal spines increasing in height to the last; mouth small, with swollen plaited lips, teeth short, scarcely visible.. **Coradion.**
f^2. Dorsal spines decreasing in height posteriorly from third or fourth.
g^1. None of the dorsal spines elongated.
h^1. Scales in lateral series 55 to 60; dorsal rays 17 or 18; anal rays 14.. **Microcanthus.**
h^2. Scales in lateral series 60 to 75; dorsal rays 24 or 25; anal rays 19 to 21.. **Hemitaurichthys.**
g^2. Fourth dorsal spines elongated, sometimes excessively so, with threadlike tip .... **Heniochus.**
e^2. A long stout spine at lower posterior angle of preopercle; posterior margin of preopercle serrate or spinous..................... **Holacanthus.**

Genus CHELMON Cuvier

Chelmon CUVIER, Règne Anim. ed. 1 2 (1817) 344; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 65.
Chelmo GÜNTHER, Cat. Fishes 2 (1860) 35.

The body strongly elevated and compressed, with an elongate, slender, tubular snout, the mouth forming a small anterior horizontal cleft; the dorsal has 9 spines, none of them elongate; the scales of moderate size, 45 to 55 in a longitudinal series; the palate toothless, the preoperculum unarmed.

The species are few, probably not more than two, and occur from the east coast of Africa to China and Australia. They are typical coral-reef dwellers, and do not enter the mouths of rivers. We need not give credence to the early tales about their shooting insects with drops of water, since there are no bushes or insects about the places where they live.

CHELMON BOSTRATUS (Linnæus). Plate 3, fig. 1.

Chætodon rostratus LINNÆUS, Mus. Ad. Fried. 1 (1754) 61, pl. 33, fig. 2; BLOCH, Ichtyologie 6 (1788) 57, pl. 202, fig. 1.
Chelmon rostratus CUVIER, Règne Anim. ed. 1 2 (1817) 190; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 66; PETERS, Monatsber. Akad. Wiss. Berlin (1868) 257; BLEEKER, Atlas Ichthy. 9 (1878) 22, pl. 369, fig. 2; DAY, Fishes of India (1878) 110, pl. 28, fig. 2; JORDAN and SEALE, Bull. Bur. Fisheries 26 (1906) (1907) 33; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 (1922) 56; AHL, Chaetodontidae, 12, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Dorsal IX, 26 to 30; anal III, 18 to 21; there are 45 to 48 scales in a lateral series, 10 or 11 between the lateral line and the origin of dorsal, and 20 to 22 between the lateral line and the origin of anal.

The body very deep and strongly compressed, the back very much elevated, very trenchant, the depth contained from 1.5 to 1.7 times in the length; the head, which is rather deep, is 2.1 to 2.3 times in the length of body, its upper profile concave from tip of snout to neck; the small, compressed caudal peduncle deeper than long, the depth 4 to 4.8 times in length of head or 9 to 10.6 times in that of body; the interorbital space slightly convex, 5.6 to 7.2 times in head or narrower than the diameter of the circular eye which is contained from 4 to 5.3 times in the length of the head; the snout almost horizontal, nearly twice in head, the jaws produced into a long cylindrical tube, with the small mouth at its extremity, the gape of mouth about two-thirds diameter of eye; the minute teeth arranged in villiform bands in each jaw; the wide preorbital about two-thirds eye, its lower edge finely denticulated; at upper rim of orbit there are small but fine teeth; two nostrils present in front of each eye, the anterior one margined behind with a fleshy flap and the posterior one a simple oblique slit.

The scales covering body moderate in size, those on the fins small to minute; the lateral line is strongly arched and extends to base of caudal fin; the dorsal spines evenly graduated to the last, which is highest, being 1.4 to 1.7 times in length of head; the soft vertical fins highest at about middle, the dorsal slightly angular and the anal rounded; the caudal fin a little convex; the small, rounded pectoral nearly as long as last dorsal spine, its posterior end above base of anal spines; the ventral fin is pointed and ends at base of anterior anal rays, its spine strong and about as long as third anal spine.

The ground color in alcohol very pale or whitish to yellowish brown, traversed by five brownish bands which are edged with brown and white; the first one across head through eye; the three middle ones below dorsal fin; and the last one, which is darker than the others, around tail; a round, black, white-edged spot in the middle of soft dorsal fin near its base; a narrow brownish band, edged with brown and white, running along median line of head; all the fins are colored similarly to body; the soft dorsal and anal narrowly edged with brown and white.

We have studied the following specimens, varying in length from 53 to 90 millimeters:

Manila Bay, 1.
Bantayan Island, 9.
Cebu, Cebu Province, 2.
Estancia, Panay, 3.
Dumangas, Panay, 1.
Inabanga, Bohol, 2.
Tawitawi, Sulu Province, 1.
Sitankai, Sulu Province, 2.

Jagor collected this beautifully marked and trimly elegant fish on the coral reef at Paracale, Camarines Norte, as recorded by Peters, and Jordan and Seale had specimens from Cavite. Elsewhere it occurs from the east coast of Africa through the seas of India and the Malay Archipelago, northward to China, and southeast to the west coast of Australia.

Genus FORCIPIGER Jordan and McGregor

Forcipiger Jordan and McGregor in JORDAN and EVERMANN, Bull. 47, U. S. Nat. Mus. 2 (1898) 1671.

This genus is characterized by its long, high spinous dorsal composed of 12 stout spines; the snout very long and slender, with short, forcepslike jaws at lip; the scales small, 70 to 80 in a longitudinal series; the body exceedingly deep and greatly compressed. One species is known.

FORCIPIGER LONGIROSTRIS (Broussonet). Plate 3, fig. 2.

Chætodon longirostris BROUSSONET, Descrip. Ichth. 1 (1782) 23, pl. 7.

Chelmon longirostris CUVIER, Règne Anim. ed. 1 2 (1817) 334, pl. 175.

Chelmo longirostris GÜNTHER, Cat. Fishes 2 (1860) 38; Fische der Südsee 2 (1874) 48; DAY, Fishes of India (1878) 109.

Prognathodus longirostris BLEEKER, Atlas Ichth. 9 (1878) 23, pl. 366, fig. 5.

Forcipiger flavissimus JORDAN and MCGREGOR, Rept. U. S. Fish. Comm. 24 (1898) 279.

Chelmon (Forcipiger) longirostris STEINDACHNER, Denkschr. Ak. Wiss. Wien 70 (1900) 499.

Forcipiger longirostris FOWLER, Proc. Ac. Nat. Sci. Phila. (1900) 512; JORDAN and EVERMANN, Bull. U. S. Fish. Comm. 23[1] (1903) 363, pl. 46; WEBER, Fische Siboga Exped. (1913) 310; AHL, Chaetodontidae, 8, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Dorsal XII, 23; anal III, 17 or 18; there are 57 to 60 scales in a lateral series, 14 between the lateral line and the origin of dorsal, and 28 between the lateral line and the origin of anal.

The body very deep and compressed, its greatest depth at anal opening, and contained 2.3 times in length; the small, low head 2.1 to 2.2 times in length of body, its upper profile very strongly concave; the least depth of the small caudal peduncle deeper than its length, 6 to 6.4 times in length of body; the slightly convex interorbital space contained 7.3 to 7.8 times in head; the circular eye situated nearly in the middle of length of head without the beak, its diameter contained from 5.4 to 6 times in head or a little longer than width of interorbital space; the snout nearly horizontal and contained 1.7 times in head, the jaws equal and produced into a long, nearly tubular beak, at the end of which is the small mouth; the extremely wide preorbital 1.3 to 1.5 times diameter of eye, its inferior edge indistinctly serrated; the teeth minute, in villiform bands in jaws; in front of eye are two nostrils, the anterior one in a low fleshy tube and the posterior one an oblique slit.

The scales moderate in size, a low sheath of small scales covers base of spinous dorsal; small to minute scales almost completely cover both the rayed dorsal and anal; the strongly arched lateral line not concurrent with dorsal profile of body; the fourth, fifth, and sixth dorsal spines highest, each being 1.7 to 1.9 times in length of head; the anal spines graduated to the last, which is highest and almost twice in head; both dorsal and anal rays decrease in length posteriorly; the caudal fin rather small and slightly emarginate, its upper ray slightly produced; the falcate pectoral is long and nearly equals head and an eye diameter more and extends posteriorly to above base of anterior anal spines; the ventral fins long and sharply pointed, reaching to base of anal spines.

Two fresh specimens collected at Tagapula Island were brilliant yellow, color deeper and shaded with orange behind; a larger, black, triangular patch covered nape, upper surface of head, and side down to level of lower edge of eye from tip of snout to opercular region; the lower parts of head and breast were livid white; the caudal fin was grayish and the other fins yellow; the anal fin had a large black circular spot at its posterior angle; both soft dorsal and anal had a narrow black margin.

In alcohol the ground color is whitish yellow, the nape and head above the level of lower margin of orbit blackish brown; the caudal fin grayish and the other fins whitish yellow; the soft vertical fins narrowly margined with grayish; a large black circular spot on posterior rays of anal.

Here described from three specimens, 118 to 140 millimeters long, taken at Hamilo, Batangas Province, and Tagapula Island, Samar.

This curious and brightly colored fish, not hitherto known from the Philippines, ranges from the east coast of Africa and Isle de France in the Indian Ocean eastward throughout Polynesia to the offshore islands of Mexico. Apparently it is not common anywhere.

Genus PARACHÆTODON Bleeker

Parachætodon BLEEKER, Versl. Akad. Amsterdam (2) 8 (1874) 371.

This genus is distinguished by the small number of dorsal spines (6 or 7 only) as well as by the nearly circular body; anal spines 3; the snout not much produced, the teeth small and brushlike; the preoperculum finely toothed; the dorsal elongate, the rayed portion more than four times as long as the spinous, the spines successively elongated but the anterior rays much more elevated.

PARACHÆTODON OCELLATUS Cuvier and Valenciennes.

Platax ocellatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 172.

Parachætodon ocellatus BLEEKER, Atlas Ichth. 9 (1878) 24, pl. 377, fig. 4; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 789; Bull. Bur. Fisheries 26 (1906) 33; WEBER, Fische Siboga Exped. (1913) 309; AHL, Chaetodontidae, 18, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Chætodon oligacanthus BLEEKER, Nat. & Gen. Arch. Ned. Ind. 2 (1845) 520; GÜNTHER, Cat. Fishes 2 (1860) 34, 516; DAY, Fishes of India (1878) 109; MEYER, Ann., Soc. España Hist. Nat. 14 (1885) 17.

Dorsal VI, 28 or 29; anal III, 18 to 20; there are 45 scales in a lateral series, 15 or 16 between the lateral line and the origin of dorsal, and 22 or 23 between the lateral line and the origin of anal.

The compressed body very deep, its depth 1.3 to 1.4 times in its length, the back very much elevated and highest at about base of anterior dorsal rays, the nape convex; the head shorter than deep, 3.1 to 3.4 times in length of body, its upper profile very steep and nearly straight; the depth of caudal peduncle 6.7 to 7.9 times in length of body; the strongly convex interorbital 2.7 to 3.2 times in head and approximately as wide as the length of the bluntly pointed snout, which is contained from 2.7 to 3.1 times; the eye small and rounded, its diameter 2.7 to 3.3 times in length of head; the maxillary very short and contained 3.3 to 3.8 times in head; the width of preorbital behind maxillary greater than half the eye diameter; the mouth very small and very slightly oblique; the jaws equal; two nostrils close together in front of each eye, the anterior one circular and having a high fleshy flap behind, the other an elongate slit which is nearly vertical; the preopercle coarsely serrated below and at the angle.

The scales on side of body moderately small, those covering head, vertical fins, and caudal very small; the lateral line is slightly arched and terminates below base of eighth dorsal ray from the last; the dorsal spines increase in height posteriorly, the last one about as long as head and 2.1 to 2.6 times in depth of body; the third anal spine highest, 3.6 to 5.4 times in depth of body; the dorsal and anal rays evenly graduated to the last which is lowest; the caudal fin truncate; the pectoral fin small and about as long as ventral spine, its tip above anus; the ventrals are produced into a point and extend to base of anal spines.

In alcohol the ground color is yellowish; a brown, dark-edged ocular band, which is narrower than the eye, descends from neck to breast; three brown bands, darkest at the margins, cross trunk obliquely forward and upward, the first one descending from origin of dorsal to belly, touching in front the hind portion of opercle; the second band runs from posterior dorsal spines to base of anal spines; the third band broadest, extending from anterior dorsal rays to anterior anal rays; a black rounded spot, edged with white, in the last band near base of fifth to ninth dorsal rays; both soft dorsal and anal yellowish at tips, their posterior portions brown near base, this brown color connected in front with the last brown band that crosses body; the caudal peduncle crossed by a wide vertical brown band; this has in front and behind near the edge a narrow transverse white line, bent outwardly; the pectoral, ventral, and caudal fins yellowish, the last one having a dusky edge.

Here described from twenty specimens, 34 to 105 millimeters long, from the following localities: Polillo Island and Lucena, Tayabas; Calapan, Mindoro; Estancia, Panay; Buenavista, Guimaras Island; Calbayog, Samar; and Tagbilaran, Bohol.

This species has been recorded previously in the Philippines by Günther from a half-grown specimen labeled "Philippine Islands," by Meyer from Cebu as *Chætodon oligacanthus*, and by Jordan and Seale from Negros Island and from Cavite. It is found from India through the East Indies to Waigiou, and north to the southern coast of China.

This fish is easily recognized by the form of the dorsal fin, by the transverse bands, and by the black ocellus at base of dorsal.

Genus CHÆTODON (Artedi) Linnæus

Chætodon ARTEDI, Genera (1738) 51 (nonbinomial); LINNÆUS, Syst. Nat. ed. 10 1 (1758) 272 (includes all known Chætodontidæ); CUVIER, Règne Anim. ed. 2 (1829) 189 (first restriction); AHL, Chaetodontidae, 44, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Tetragonoptrus KLEIN, Hist. Piscium (1744) 37 (nonbinomial).

Rabdophorus SWAINSON, Class. Fishes 2 (1839) 21 (scales on lower half in nearly horizontal series; scales about 45).

Megaprotodon GUICHENOT, Rev. Zool. 11 (1848) 12; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 336 (anal spines 4; scales large, 23 to 25, in oblique rows meeting at right angles).

Citharœdus KAUP, Wiegmann's Archiv für Naturg. 26[1] (1860) 136 (scales on lower half in horizontal series; scales about 50).

Linophora KAUP, Wiegmann's Archiv für Naturg. 26[1] (1860) 137 (scales in series running downward and backward).

Sarathrodus GILL, Proc. Acad. Nat. Sci. Phila. (1862) 238.

Tholichthys GÜNTHER, Ann. & Mag. Nat. Hist. IV 1 (1868) 457 (larval form).

Tetragonoptrus BLEEKER, Arch. Neerl. Sci. Nat. 11 (1876) 305 (scales below in horizontal series; spinous dorsal not more than half the length of the soft).

Chaetodontops BLEEKER, Arch. Neerl. Sci. Nat. 11 (1876) 305 (scales below in ascending series).

Lepidochætodon BLEEKER, Arch. Neerl. Sci. Nat. 11 (1876) 306 (anterior scales much enlarged).

Oxychætodon BLEEKER, Arch. Neerl. Sci. Nat. 11 (1876) 306 (scales very large, 24 to 28, the snout pointed).

Gonochætodon BLEEKER, Arch. Neerl. Sci. Nat. 11 (1876) 306.

Hemichætodon BLEEKER, Versl. Akad. Amsterdam (2) 10 (1876) 313 (scales below running downward and backward, forming an angle with those above.

Common names.—English, butterfly fish; Bicol, *kolibangbang;* Tagalog, *dalagang bukid, paro-paro;* Tao Sug and Samal, *bebang, isda kaba kaba;* Visayan, *alibangbang, tapay tapay.*

The body short, deep, very strongly compressed, especially above and behind; the small compressed head covered with scales almost everywhere; the mouth very small, terminal, the jaws with long, slender, flexible, bristlelike teeth; the preopercle entire or nearly so, without a spine; the dorsal fin usually has 12 or 13 spines, less often 11 or 14; the soft portion usually has its last rays rapidly shortened, but in some species they may be filamentous; the caudal peduncle short, the fin fan-shaped; the anal similar to soft dorsal, with 3, very rarely 4, strong spines; the body covered with ctenoid scales somewhat irregularly arranged, 24 to 54 in lateral series, those on head and vertical fins much smaller; the lateral line curved, high, more or less parallel with back, terminating at posterior extremity of soft dorsal; gill openings rather narrow, the membranes narrowly joined to the isthmus; branchiostegals 6.

Many attempts have been made to subdivide this large genus of typical coral-reef fishes, but none has been very successful. We are therefore grouping under one head all the subgenera listed above. The members of this genus occur from the east coast of Africa eastward to America, north to Japan and Hawaii, and along the eastern coast of both Americas. Most of them are remarkable for their beauty of color, and in very many languages are called butterfly fishes.

They apparently rely upon their quickness of movement to protect them from their enemies which cannot follow them into the crevices and openings of the coral. Their great depth and strong spines are likewise sufficient to protect them against most coral-reef dwellers. They feed upon minute crustaceans, worms, and other very small animals, and probably to some extent on algæ. There is no more entrancing sight than the unexpected irruption of a swarm of gorgeous chætodonts into a deep dark chasm in the reef. They flit about in the open space, illuminating the depths, only to vanish at a sign of danger into the hidden byways and crevices of the coral.

Artificial key to the Philippine species of Chætodon.

- a^1. *Megaprotodon:* Anal spines 4; dorsal spines 14; scales large, in oblique series, meeting at right angles; soft dorsal and anal elongate, with concave posterior margin; the outer row of teeth longer than the inner .... **C. strigangulus.**
- a^2. Anal spines 3 (in one species 4); posterior margin of soft dorsal and anal perpendicular or rounded; dorsal spines 11 to 14.
  - b^1. *Gonochætodon:* Body very deep, dorsal spines 11, the posterior margin of dorsal and anal nearly vertical; scales irregular; sides with nearly vertical stripes, each obtusely angled along median axis, the angle pointing forward........ **C. triangulum.**
  - b^2. *Chætodon:* Body not angulate striped as above; scales below lateral line in horizontal rows or obliquely upward or downward.
    - c^1. Anal spines 4; scales medium, in longitudinal rows below lateral line .... **C. plebeius.**
    - c^2. Anal spines 3.
      - d^1. *Linophora:* Anterior rows of scales running upward and backward, each marked by a dark line; posterior rows running downward and backward almost at right angles with anterior rows.
        - e^1. Fifth and sixth dorsal rays produced into an elongate thread .... **C. auriga.**
        - e^2. No produced dorsal rays; a broad black band across base of dorsal to middle of anal base; two black crossbands on caudal .... **C. vagabundus.**
      - d^2. Scales not marked by lines meeting at an angle.
        - f^1. Scales large, arranged in very distinct checkerboardlike rows, running both upward and backward and downward and backward.
          - g^1. No ocular band; a black saddle across interorbital, not reaching eye .... **C. argentatus.**

g^2. An ocular band present.

  h^1. Dorsal spines 12; sides checkered with brownish violet streaks following rows of scales; soft dorsal and anal with a narrow blackish submarginal line.... **C. chrysurus.**

  h^2. Dorsal spines 13 or 14; a black band on soft dorsal and a black lunate band on caudal............................ **C. rafflesi.**

f^2. Scales not in checkerboard arrangement.

 i^1. Dorsal spines 11.

  j^1. A black ocellus from third to seventh dorsal rays; dorsal rays 22; anal rays 19.................................... **C. modestus.**

  j^2. Eight blackish brown transverse bands; dorsal rays 18 to 20; anal rays 16 or 17................................ **C. octofasciatus.**

 i^2. Dorsal spines 12 or more.

  k^1. Dorsal spines 12.

   l^1. A black preopercular band or bar present.

    m^1. Ocular band with a broad white band before and behind it; a deep green or violet stripe running upward and backward between the rows of scales on side .... **C. collare.**

    m^2. A black preocular band behind mouth from snout to chin; 6 or 7 broad orange or brownish diagonal bands running upward and backward on each side .... **C. ornatissimus.**

   l^2. No black preocular band present.

    n^1. Upper part of body brownish black, inclosing one or two small whitish blotches, rarely none; sides with a row of blackish spots on each scale, running upward and backward................................ **C. melanotus.**

    n^2. Upper part of body not brownish black.

     o^1. Body with vertical bands, stripes, or lines.

      p^1. Two broad blackish vertical bands and about sixteen almost vertical blackish lines on each side of trunk .... **C. ulietensis.**

      p^2. Body with fine vertical lines along posterior margins of scale rows; a broad blackish band along soft dorsal base, across caudal peduncle, and on to posterior part of anal. **C. lineolatus.**

     o^2. Body with oblique lines or bands running downward and forward on sides.

      q^1. No basal black band on soft dorsal and caudal peduncle.

       r^1. Ocular band very wide, not uniting above with its fellow; a very small black saddle mark on nape .... **C. adiergastos.**

       r^2. Ocular band uniting above eye with its fellow; a large black wedge-shaped spot on nape and shoulder....................................... **C. bella-maris.**

      q^2. A black band at base of soft dorsal and on caudal peduncle.

s^1. Black band not extending upon anal; a broad white band behind ocular band; region between pectoral and spinous dorsal black, with 3 yellow or white converging bands in it. **C. fasciatus.**

s^2. Black crescentic band descending to middle of anal; no white band behind ocular band; anterior dorsal region of body with a spot on each scale, red or golden in life, whitish in alcohol .... **C. selene.**

k^2. Dorsal spines more than 12.

t^1. Dorsal spines 13.

u^1. No ocular band; a broad blackish band from middle of spinous dorsal back over soft dorsal, caudal peduncle, and anal; a narrow white edge on soft dorsal and anal .... **C. carens.**

u^2. An ocular band present.

v^1. Fifth dorsal ray elongate, filiform; ocular band faint; upper posterior dorsal region covered by a very large, white-edged black spot. **C. ephippium.**

v^2. None of the dorsal rays elongate and threadlike.

w^1. A wide vertical brown band on anterior part of trunk; posterior part brownish with scattered pearly spots; sometimes with 14 dorsal spines. **C. kleini.**

w^2. Body without a wide vertical band anteriorly.

x^1. Each scale on body with a basal olive spot; seven nearly vertical bands on side of body. **C. punctato-fasciatus.**

x^2. No vertical bands on trunk.

y^1. A large circular black spot on lateral line below posterior dorsal spines; sometimes a wedge-shaped area extends downward from lateral spot........ **C. unimaculatus.**

y^2. Body with many violet or brown parallel or slightly oblique streaks; a dark band on base of dorsal, anal, and across middle of caudal .... **C. trifasciatus.**

t^2. Dorsal spines 14.

z^1. A large black spot on each side of body.

aa^1. A circular, white-margined, black ocellus on lateral line below posterior dorsal spines; two oblique pearl bands from opercle toward anal, one above and one below pectoral........ **C. bennetti.**

aa^2. A black ovate spot about the size of head on lateral line below middle of dorsal; no conspicuous lateral bands .... **C. speculum.**

z^2. No large lateral spot; body yellowish, a blue spot on each scale; anal with wide black margin; other fins plain........ **C. citrinellus.**

Subgenus MEGAPROTODON Guichenot

Megaprotodon GUICHENOT, Rev. Zool. 11 (1848) 12; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 336.

This group is distinguished by always having four anal spines instead of three, and by the scales on the body being large and arranged in oblique series which meet at right angles. The oblong body laterally compressed, with the soft dorsal and anal elongated and with concave posterior margin; the snout neither tubulate nor elongate; the outer teeth of lower jaw slightly longer than the inner teeth.

Species few, occurring from the Red Sea to the islands of Polynesia.

CHÆTODON (MEGAPROTODON) STRIGANGULUS (Solander). Plate 4, fig. 1.

Chætodon strigangulus Solander apud GMELIN, Syst. Nat. ed. 13 (1788) 1269; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 52, pl. 172; BENNETT, Zoology Beechey's Voyage, Fishes (1839) 60, pl. 17, fig. 2; GÜNTHER, Cat. Fishes 2 (1860) 4; Fische der Südsee 1 (1873) 35, pl. 26, fig. A; WEBER, Fische Siboga Exped. (1913) 308; AHL, Chaetodontidae, 179, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Megaprotodon strigangulus BLEEKER, Atlas Ichthy. 9 (1878) 54, pl. 375, fig. 1.

Chætodon trifascialis QUOY and GAIMARD, Zool. Voy. Uranie 2 (1824) 379, pl. 62, fig. 5.

Chætodon taunayi QUOY and GAIMARD, Zool. Voy. Uranie 2 (1824) 379, pl. 62, fig. 5; GÜNTHER, Cat. Fishes 2 (1860) 5.

Chætodon triangularis RÜPPELL, Atlas Reise Nördl. Afrika, Fische des Rothen Meers (1828) 42, pl. 9, fig. 3.

Chætodon leachii CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 37; GÜNTHER, Cat. Fishes 2 (1860) 6.

Chætodon bifascialis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 37.

Megaprotodon trifascialis JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 336.

Dorsal XIV, 15 or 16; anal IV, 15; there are 23 to 25 scales in a lateral series, 9 between the lateral line and the origin of dorsal, and 14 between the lateral line and the origin of anal.

The depth of the compressed, oblong-oval body contained 2 to 2.2 times in the length, the back a little more elevated than the ventral; the head nearly as long as deep, being 3.1 to 3.4 times in length of body, its upper profile nearly straight in the large specimen and a little concave in front of eyes; the caudal peduncle deeper than long, 9.1 to 9.2 times in length of body or 4.1 to 4.6 times in depth; the evenly convex interorbital 3 to 3.1

times in length of head; the large circular eye in middle of head, its diameter as long as the pointed snout, which is contained 2.8 times in head; the maxillary 3.7 to 4.3 times in head and slightly longer than width of preorbital, which is contained 4.5 to 4.8 times; the mouth small, its gape slightly oblique, lower jaw slightly in advance of upper; the two nostrils in front of each eye very close together, the anterior one circular and having a high fleshy flap behind, the other simple, oval and slightly oblique; the inferior and posterior edges of preopercle serrated.

The scales on sides of trunk large, arranged in strongly oblique series forward and upward, those on head and fins small to minute; the lateral line is very slightly arched and in our specimens ends on the third or fourth scale before the axil of the soft dorsal, to which it sometimes extends; the dorsal spines evenly graduated to the last, which is 1.3 times in head; the fourth anal spine as long as second and third and 1.2 times in head; the soft dorsal acutely angular, the angle of anal slightly rounded; the caudal fin a little convex, the pectoral small and pointed above, extending to within two scales before vertical through anus; the ventral does not quite extend to anus, its spine 1.6 to 1.7 times in head.

The ground color in alcohol yellowish brown above and yellowish below; the body has about twenty narrow blackish or grayish blue, V-shaped cross stripes, the angles bent toward head, their centers on a line between eye and middle of caudal peduncle; on each side of body two oblong whitish blotches, one on anterior and one on posterior half; a white-edged, blackish ocular band, about as wide as eye, descends from back of neck to anterior portion of breast; the caudal fin is black and has a narrow, submarginal, black crossband bordered on each side with yellowish; the soft vertical fins narrowly edged with whitish and provided with a narrow submarginal black line; the pectoral yellowish and the ventral whitish.

The two examples above described are 67 and 81.5 millimeters in length and were collected at Calapan, Mindoro, and Tambagaan Island, Sulu Archipelago.

This species, which has not been hitherto recorded from the Philippines, is known to occur from the Red Sea to Guam and Samoa.

Subgenus GONOCHÆTODON Bleeker

Gonochætodon BLEEKER, Syst. Percarum revisum, Arch. Neerl. Sci. Nat. 11 (1876) 306.

The snout short, pointed, the body very deep and rhomboid; the posterior margin of dorsal and anal fins nearly vertical; the scales on sides in irregular series; sides with alternating lighter and darker, very distinct vertical stripes, each obtusely angled along median axis, the angle pointing forward; 11 dorsal spines, the soft dorsal angulate; anal spines 3, the fin round-angled.

Only one species of this subgenus is known.

CHÆTODON (GONOCHÆTODON) TRIANGULUM (Kuhl and Van Hasselt). Plate 5, fig. 1.

Chætodon triangulum Kuhl and Van Hasselt in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 34; AHL, Chaetodontidae, 174, in Archiv für Naturg. 89 (1923) Abt. A, Heft. 5.

Gonochætodon triangulum JORDAN and SEALE, Bull. Bur. Fisheries 26 (1907) 33; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 269.

Tetragonoptrus triangulum BLEEKER, Atlas Ichth. 9 (1878) 53, pl. 374, fig. 1.

Chætodon baronessa CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 34; GÜNTHER, Cat. Fishes 2 (1860) 31.

Dorsal XI, 24 to 27; anal III, 21 to 23; there are 30 to 32 scales in a lateral series, 9 to 11 between the lateral line and the origin of dorsal, and 9 to 11 between the lateral line and the origin of anal.

The strongly compressed body very deep and nearly circular, depth 1.3 to 1.4 times in length; the head, which is slightly shorter than deep, contained from 3 to 3.4 times in length of body, its dorsal profile in front of eye markedly concave and above eye very steep; the depth of the strongly compressed and short caudal peduncle 8.1 to 8.9 times in length of body; the moderately convex and narrow interorbital contained from 3.2 to 3.8 times in head; the small circular eye nearer to tip of snout than to vertical through posterior edge of opercle, its diameter longer than width of interorbital and 2.7 to 3.2 times in head; the snout rather produced, short, conical, 2.9 to 3.1 times in length of head; the short maxillary 3.5 to 4.3 times in head, as long as or slightly longer than width of preorbital which is about two-thirds the eye; the mouth very small and oblique, the jaws even; there are two nostrils close together in front of each eye, the more anterior circular and having a fleshy rim, the posterior portion very high, the other an oblique streak pointing upward and backward; the preopercle serrated.

The scales on each side of trunk moderate in size and in regularly oblique series, those on head, vertical fins, and caudal small to minute; the evenly and moderately arched lateral line terminates below base of the middle portion of the rayed dorsal fin or at about the ninth to the twelfth scale from axil of fin; the dorsal spines increase in height posteriorly, the last one being 2.3 to 3 times in depth of body, the third anal spine slightly lower and contained 2.6 to 3.2 times; the soft portions of dorsal and anal highly elevated, the latter more broadly rounded; the caudal fin slightly convex; the pectoral fin a little shorter than head and about as long as last dorsal spine, its tip above anus; the ventral fin extends to origin of anal, its spine 3.4 to 3.7 times in depth of body.

The sides of body have alternating lighter and darker stripes, which are angularly bent with the angle pointing forward, the lighter stripes becoming narrower posteriorly. In life the lighter stripes bright lemon yellow, the darker ones across head deep violet-brown, and those on trunk lilac to blackish brown posteriorly and upon the fins; the lips reddish; the dorsal spines pinkish near base and reddish on their outward portions; the soft dorsal is edged with blackish and has a submarginal band of lilac, which fades in front into the pinkish portion of spinous dorsal, the lilac submarginal band bordered on inner side by a narrow blackish line; the rayed anal is edged with bright lemon yellow and has a submarginal black line; the blackish brown areas on the soft vertical fins fade into reddish outwardly; the membranes of the anal spines reddish and narrowly edged with bluish; the blackish brown caudal is edged with grayish and has a submarginal band of yellowish, this band bordered in front with blackish; both pectoral and ventral fins bright lemon yellow; caudal peduncle has a narrow vertical band of like color which extends upon anal. In alcohol, the lemon yellow areas on head, trunk, and fins have become whitish to very light yellowish, the darker stripes have turned into very light lilac to blackish; the reddish color on lips and vertical fins has faded into yellowish; the blackish markings have become lighter.

We have examined numerous specimens of this species in the Bureau of Science collection, the largest 96 millimeters in length. They were collected at the following localities: Maricaban Island, Batangas; Calapan, Mindoro; Capul Island, Samar; Gigantangan Island, Leyte; Quiminatin Island, Cuyo Islands; Balabac Island; and Tubigan Island, Sulu Archipelago.

This fish is rather abundant in Calapan, Mindoro, where most of the examples were collected. There are living specimens in the Bureau of Science aquarium. It has been recorded previously from the Philippines, either Manila or Iloilo, by Jordan and Seale, and by Jordan and Richardson from Cagayancillo. This species is abundant from Sumatra to New Guinea. We follow Ahl in separating the Red Sea forms described as *C. larvatus* and *C. karraf*, and often included with the present species.

CHÆTODON PLEBEIUS Broussonet. Plate 6, fig. 1.

Chætodon plebeius Broussonet in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 52.

Chætodon plebejus GÜNTHER, Cat. Fishes 2 (1860) 5; Fische der Südsee 1 (1873) 35, pl. 32, fig. B; DAY, Fishes of India (1878) 104, pl. 26, fig. 3; STEINDACHNER, Sitzungsb. Akad. Wiss. Wien 102 (1893) 227; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) 345; AHL, Chaetodontidae, 54, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Dorsal XIII, 18; anal IV, 15; there are 36 scales in the lateral line, 7 between the lateral line and the origin of first dorsal, and 14 between the lateral line and the origin of anal. According to Ahl, the dorsal is XIV, 17 to 19; anal IV to V, 15 to 17.

The oblong-ovate body moderately thick anteriorly, strongly compressed posteriorly; the dorsal and ventral anterior profiles similar, the upper one forming nearly a straight line from dorsal to tip of snout, the ventral profile a little more convex; the greatest depth 1.7 times, the head 3.3 times in length; the short blunt snout equals the circular eye and is 3.5 times in head; the lightly convex interorbital a little more than eye, 3 times in head; the preoperculum practically smooth, with a few microscopic denticulations on lower limb; the mouth small, horizontal, the jaws equal, the short maxillary 3.8 times in head; the nostrils small, close together, nearly circular, a little above median axis of eye, the anterior one with a small posterior valve; the least width of preorbital 4.7 times in head, 1.3 times in eye; the least depth of caudal peduncle greater than its own length and 9.7 times in body length, 2.9 times in head.

The scales on body of medium size, in longitudinal rows except on upper part, where they are arched; they are smaller posteriorly, small to very small on fins and head; the arched lateral line extends back as far as posterior extremity of soft dorsal; the sixth dorsal spine is highest and equals second and third anal spines and ventral spine, 1.6 times in head; the soft dorsal rounded behind, the anal gently angulate; the caudal diagonally truncate, the upper part more elongate than the lower; the pectoral 1.3 times in head.

The color in life clear bright lemon yellow all over, including the fins, except the pectoral and posterior part of caudal, with a longitudinal line of golden yellow along middle of each row of scales; near the dorsal the rows become brown or umber; around mouth and pectoral base the color is orange to reddish orange; on upper part of side, along and below lateral line, is a very large, elongate, oval, violet-black spot with vaguely defined boundaries, extending from the fifth scale of the lateral line to the twenty-eighth; it is more than one and a half times as long as head and its greatest depth is one and a half times eye; on caudal peduncle is a large, deep black, oval spot; a violet blackish brown ocular band with violet-blue margins, and narrower than eye, passes down each side from nape to throat; the two ocular bands do not meet on nape, and each is broken by a golden spot a little way below its origin; the pectoral and posterior part of caudal clear, the ventrals bright yellow anteriorly, the rest colorless.

In alcohol the colors are a little changed, the longitudinal stripes darker, the brilliance of the yellow color dimmed; the posterior margin of both anal and soft dorsal colorless.

Here described from a specimen, 116 millimeters long, collected on the coast of Tablas.

This beautiful and unique *Chætodon* is apparently very rare. For a long time it was known only from Broussonet's type specimen in the British Museum. Sir Francis Day collected it in the Andamans and Steindachner received nineteen specimens from Fiji. Ahl examined a specimen from Fiji and one from New Guinea. The only figure hitherto published is from a drawing made by Andrew Garrett. Neither his painting nor Broussonet's type showed the lateral elongate blotch.

In the character of the anal spines this handsome fish belongs with *Megaprotodon*, but it differs strongly in the arrangement of the scales and the shape of the body.

CHÆTODON AURIGA Forskål. Plate 7, fig. 2.

Chætodon auriga FORSKÅL, Descrip. Anim. (1775) 60; GÜNTHER, Cat. Fishes 2 (1860) 7; DAY, Fishes of India (1878) 106, pl. 27, fig. 3 (var. *setifer*); VAILLANT, Nouv. Arch. Mus. Paris III 5 (1893) 58 (var. *setifer*); EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1907) 96; AHL, Chaetodontidae, 147, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Chætodon setifer BLOCH, Ichtyologie 12 (1797) 99, pl. 425, fig. 1; LESSON, Voy. Coquille, Zoologie 2 (1830) 175, pl. 29, fig. 2 (1826); GÜNTHER, Cat. Fishes 2 (1860) 6; Fische der Südsee 1 (1873) 36, pl. 26, fig. B; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 269.

Tetragonoptrus auriga BLEEKER, Atlas Ichthy. 9 (1878) 47, pl. 373, fig. 4.

Chætodon sebanus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 57.

Dorsal XIII, 23 to 25; anal III, 20 or 21; there are 20 scales in a lateral series, 8 between the lateral line and the origin of dorsal, and 15 to 17 between the lateral line and the origin of anal.

The body very deep and strongly compressed, its depth contained from 1.6 to 1.7 times in length, the back much elevated and very trenchant; the head longer than deep, 2.7 to 3 times in length of body, its upper profile markedly concave; the caudal peduncle much deeper than long, its least depth 8.6 to 9.1 in length of body; the broad convex interorbital 3.5 to 4 times in length of head, and approximately as wide as the diameter of the circular eye, which is contained from 3.5 to 3.9 times; the eye superior and midway in head; the produced and pointed snout rather long, 2.3 to 2.6 times in head; the maxillary 3.4 to 3.9 times in head; the preorbital nearly as wide as eye and 3.4 to 4 times in head; the very small mouth is nearly horizontal, with the jaws equal; in front of each eye are two small nostrils, the anterior one circular and provided with a high fleshy flap on its posterior border, the other a simple, slightly oblique slit; the preopercle indistinctly serrated behind and below.

The scales on each side of body very large and in regular, very oblique series, those on head, vertical fins, and caudal peduncle becoming very small; the lateral line is very high and convex, and does not quite reach to base of last dorsal rays; the dorsal spines increase in height posteriorly, the last one 1.4 to 1.6 times in length of head; the third anal spine a little higher than second and 1.4 to 1.8 times in head; the soft dorsal forms an angle in the middle, the fifth and sixth rays longest and produced into a more or less elongated thread; the soft anal rounded, the caudal truncate; the pectoral shorter than head and 2.1 to 2.4 times in depth of body, reaching to within two scales of a perpendicular from anus; the pointed ventral does not extend to anus, its spine 1.8 to 2.1 times in head.

In life the general color is pearl gray in front and below, including ventrals, with a faint tinge of violet, changing abruptly to deep orange yellow behind and on vertical and caudal fins; on each side of body behind head is a series of five violet-gray lines running upward and backward to base of dorsal spines; at right angles to these are ten or twelve similar lines running from the last line downward and backward toward anal; a broad, white-edged black vertical band, narrowing and sometimes, with age, disappearing above, passes through eye and meets the opposite one below; the lips pinkish; the soft dorsal is edged with black and has a large rounded black spot near margin; the anal is yellowish on its outer edge and has a narrow submarginal band of black; the caudal fin is broadly tipped with light violet and has two fine submarginal lines of blackish; the pectoral grayish.

In alcohol the color of body almost uniformly yellowish brown, with five deep brown or blackish lines or bars running obliquely upward and backward behind head; at right angles to posterior one are ten or twelve lines or bars extending down and back to belly and on anal; the ocular band, the large rounded spot on soft dorsal, and the narrow edge to the soft dorsal are black; the submarginal lines on anal and caudal fins blackish.

This description is based upon the following specimens, ranging in length from 19 to 137 millimeters. They are from the following localities:

Currimao, Ilocos Norte, 2.
Luna and Balaoan, La Union, 4.
Mariveles, Bataan, a ripe female, 124 millimeters long, collected April 24, 1922.
Aloneros, Tayabas, 1.
Batangas Province, a ripe female, 137 millimeters long, collected March 15, 1925.
Calapan, Mindoro, 56.
Elefante Island, Marinduque, 1.
Simara Island, Romblon Province, 1.
Capul Island, Samar Province, 1.
Canigaran, Palawan, 1.
San Juan, Siquijor, 1.
Zamboanga, Mindanao, 1.
Tawitawi, Bilatan, and Sibutu Islands, Sulu Archipelago, 7.

This common species has been recorded previously in the Philippines by Vaillant from Palawan, and by Jordan and Richardson from Cagayancillo. It is very common throughout the tropical Indo-Pacific region from the Red Sea to the Samoan and Hawaiian Islands, and northward to the Riu Kiu Archipelago.

The species appears closely related to *Chætodon vagabundus* Linnæus, from which it differs in having only five grayish lines running obliquely forward from base of spinous dorsal toward nape, and in the absence of the broad black vertical bands crossing caudal and the soft vertical fins.

According to Ahl our fish is the subspecies *setifer*, the subspecies *auriga* occurring only in the Red Sea.

CHÆTODON VAGABUNDUS Linnæus. Plate 5, fig. 2.

Chætodon vagabundus LINNÆUS, Syst. Nat. 1 (1758) 465; BLOCH, Ichtyologie 7 (1788) 64, pl. 204, fig. 2; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 38; GÜNTHER, Cat. Fishes 2 (1860) 25; DAY, Fishes of India (1878) 105, pl. 27, fig. 1; MEYER, Ann., Soc. España Hist. Nat. 14 (1885) 17; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1906) (1907) 96; AHL, Chaetodontidae, 153, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus vagabundus BLEEKER, Atlas Ichth. 9 (1878) 48, pl. 378, fig. 1.

Chætodon nesogallicus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 48, young; GÜNTHER, Cat. Fishes 2 (1860) 10.

Dorsal XIII, 22 to 26; anal III, 19 to 21; there are 30 to 35 scales in a lateral series, 6 between the lateral line and the origin of dorsal, and 16 between the lateral line and the origin of anal.

The body deep and strongly compressed, the back very much elevated, the depth 1.5 to 1.7 times in length; the head rather small, about as long as deep, 3 to 3.4 times in length of body, its upper profile very steep and slightly arched; the depth of the small caudal peduncle 8.5 to 9.7 times in length of body; the interorbital space slightly convex and contained from 3.2 to 3.7 times in head; the diameter of the circular eye longer than width of interorbital and from 2.8 to 3.1 times in head; the snout a little produced and pointed, 2.6 to 2.8 times in length of head and longer than maxillary, which is contained 3.5 to 3.9 times; the width of preorbital behind maxillary more than two-thirds the length of eye; the mouth rather small, with the jaws even; two nostrils close together in front of each eye, the anterior one circular and provided with a fleshy rim, the posterior portion of which is a high flap, the other nostril an oblique slit; the hind and lower edges of preopercle finely serrated.

The scales on side of body very large, becoming very small on the soft vertical fins and on caudal; the lateral line is strongly arched and extends to below base of posterior dorsal spines; the posterior dorsal spines lower than the middle ones, the last one of the dorsal being 1.3 to 1.7 times in length of head; the second anal spine about as long as third, which is from 1.3 to 1.4 times in head; the soft portions of dorsal and anal obtusely angular; the caudal fin slightly convex; the pectoral about as long as head, longest and pointed superiorly, its posterior end a little before vertical passing through anus; the ventral does not quite reach anus, its spine 1.5 to 1.7 times in length of head.

In life the ground color was straw yellow; the side of the body had six narrow black lines passing downward and forward from base of spinous dorsal toward anterior portion of trunk above pectoral, and the other lines of similar color ran obliquely downward toward anal fin; there was a black ocular band about as wide as eye running across head from origin of dorsal to inferior margin of interopercle; the soft dorsal was bright orange yellow and had a very narrow whitish margin, below which there was a blackish band, broadest toward the highest rays; near its base another black band which curved down across caudal peduncle and continued upon the upper part of anal fin; the anal fin was also bright orange yellow and had a narrow blackish and white margin; the caudal fin was bright orange yellow and had two black crossbands, the more anterior one crescent-shaped, the outer portion of fin colorless; the spinous dorsal, anal, pectoral, and ventral were colored similarly to body.

The ground color has turned into yellowish brown in alcohol, the black bands and lines on head, body, and fins have become deep brown, while the orange yellow of caudal and the soft vertical fins has faded into yellowish.

The above description was taken from a study of thirty-six specimens in the Bureau of Science collection. They measure from 30 to 120 millimeters in length, and were taken at Currimao, Ilocos Norte; Balaoan, La Union; Iba, Zambales; Mariveles, Bataan; Aloneros, Tayabas; Calapan, Mindoro; Gigantangan Island, Leyte; Tagbilaran, Bohol; Clarendon Bay, Balabac; Zamboanga, Mindanao; and Pearl Bank, Basbas, Bungau, Bilatan, Sibutu, and Sitankai Islands, Sulu Archipelago.

This species has been previously recorded in the Philippines from Bacon, Sorsogon, by Evermann and Seale, and elsewhere is known to be very abundant in the East Indies and the South Sea Islands. It ranges from the Red Sea and the east coast of Africa eastward to Samoa and extends northward to Okinawa, Riu Archipelago.

CHÆTODON ARGENTATUS Smith and Radcliffe. Plate 4, fig. 2.

Chætodon argentatus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus. 40 (1911) 319, fig. 1.

Dorsal XIV, 22; anal III, 16; there are 33 scales in a longitudinal series, 4 above and 10 below the lateral line; 22 transverse rows of scales between the opercle and the end of last vertebra.

The general form is nearly rhomboidal, its depth 1.63 in the length, strongly compressed laterally, the small pointed head deeper than long, 3.12 times in the length, its upper profile slightly concave, and somewhat irregular; the circular eye 3 times in head, the conical snout a little longer, 2.64 in head; the maxillary 3.42 in head, barely reaching a vertical from anterior nostril; the nostrils close to eye, the anterior nostril the larger, circular, with a posterior flap, the posterior nostril elongate and slitlike; the very slightly rounded interorbital 3 times in head; the preopercular border smooth except for a few weak teeth near upper angle and on horizontal margin; the long slender teeth are in bands and have a slight constriction near the top; the slender caudal peduncle shorter than its depth, 3 times in head; the silvery peritoneum has scattered dusky spots.

The scales on middle of trunk larger than the rest, and arranged in very distinct rows, both upward and backward and downward and backward; the head, belly, and vertical fins finely scaled.

The dorsal spines long, slender, the fourth one longest, 1.26 in head, membrane of anterior spines deeply incised; soft dorsal moderately low, evenly rounded; caudal short, obliquely truncate; anal bluntly right-angled, second and third spines subequal, the second slightly stronger than the third; ventrals 1.14, short, tips not reaching vent; pectoral 1.1.

Color in alcohol silvery, tinged with very pale lemon yellow; a narrow black saddle across upper part of interorbital, not reaching eye; a small black area on upper part of eye and adjacent interorbital region; an irregular black saddle from in front of origin of dorsal downward across upper part of opercle, duskiness extending across upper part of preopercle to posterior margin of eye; a black area crossing fifth to ninth dorsal spines and extending downward to middle of side; a broad black band including last dorsal spine and anterior third of soft dorsal extending downward and backward across base of soft dorsal, caudal peduncle, and posterior third of anal; margin of soft dorsal silvery white, the tips of the rays very narrowly edged with black, a narrow inframarginal black line below marginal band, area between this and the broad black band crossing base of fin dusky white; a blackish segment on tips of middle caudal rays; anterior to this a similar white band preceded by a black crescent fading out on base of fin; anterior two-thirds of anal silvery white, posterior third black; dusky or blackish lines extending downward and backward or upward and backward along the rows of scales, forming a checkerboard arrangement and emphasizing the scale arrangement.

The above description is that of the type, 96 millimeters in length, collected at Agojo Point, Catanduanes Island, off the coast of southeastern Luzon.

Another specimen, 85 millimeters long, taken at Port San Pio V, Camiguin Island, north of Luzon, had no yellow in life; the pale parts were silvery, the darker parts black; the black markings are more pronounced than in the type, the black and white markings of the caudal more distinct; the black saddle on the interorbital is interrupted on the right side.

The above description is taken from that by Smith and Radcliffe, who described the only specimens known, collected by the *Albatross* when in Philippine waters.

CHÆTODON CHRYSURUS Desjardins. Plate 8, fig. 1.

Chætodon chrysurus DESJARDINS, Proc. Zool. Soc. (1833) 117; DAY, Fishes, Fauna Brit. India 2 (1889) 6; AHL, Chaetodontidae, 161, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Chætodon xanthurus BLEEKER, Act. Soc. Sci. Indo-Neerl. 2 (1857) 53; GÜNTHER, Cat. Fishes 2 (1860) 29; SAUVAGE, Poissons, in Hist. de Madagascar (1875) 261, pl. 29, fig. 1.

Chætodon mertensi (not Cuvier and Valenciennes) DAY, Fishes of India (1878) 105, pl. 27, fig. 2.

Tetragonoptrus mertensi (not Cuvier and Valenciennes) BLEEKER, Atlas Ichth. 9 (1878) 50.

Tetragonoptrus xanthurus BLEEKER, Atlas Ichth. 9 (1878) pl. 378, fig. 3.

Dorsal XIII, 22; anal III, 17; there are 29 or 30 scales in a lateral series, 8 between the lateral line and the origin of dorsal, and 14 between the lateral line and the origin of anal.

The body deep and much compressed, with the back very highly elevated; the depth contained 1.8 times in length; the head, which is very slightly shorter than deep, is 3.2 times in length of body, its upper profile steep, and a little concave in front of eye; the moderately wide and convex interorbital as wide as preorbital, which is 3.8 times in head or more than two-thirds eye diameter; the circular eye fairly large and slightly closer to tip of snout than to the point above posterior edge of opercle, its diameter 3.2 times in head; the snout slightly produced, pointed, slightly longer than eye, 2.9 times in head; the maxillary a trifle shorter than eye and 4 times in head; the mouth small and horizontal, the jaws even; the two nostrils close together in front of eye, the anterior one circular and having a fleshy rim which is highest behind, the posterior one an ovoid and simple opening; the preopercle indistinctly serrated.

The scales on each side of body rather irregular in size, those on spinous dorsal and below it toward belly and anal fin rather large; the scales covering nape, head, breast, caudal, and the soft portions of the vertical fins small to minute; the lateral line is moderately arched and terminates on the fourth scale in front of axil of dorsal fin; the middle dorsal spines about as high as posterior ones, the last 1.4 times in head; the third anal spine as long as pectoral which is 2.1 times in depth of body; the rayed dorsal more broadly rounded than the soft anal; the caudal fin convex; the pectoral is short and does not quite extend to the vertical line passing through anus; the ventral fin reaches base of anal spines, its spine 1.4 times in length of head.

The ground color in alcohol yellowish white; each side of body checkered with oblique brownish violet streaks which cross each other and follow the series of scales; the black ocular band, which is narrower than the eye, edged on both sides with white; a white-edged, horseshoelike black saddle on top of neck; the soft portions of dorsal and anal are narrowly edged with yellowish and have a very narrow blackish submarginal line; the other fins colored similarly to body.

Here described from the only specimen in the Bureau of Science collection. It measures 86 millimeters in length and was obtained at Puerto Galera, Mindoro, in March, 1912.

This species, which is new to the Philippines, occurs from the Red Sea and Madagascar through the seas of India to Sumatra and eastward to New Britain, in the Bismarck Archipelago.

CHÆTODON RAFFLESI Bennett. Plate 6, fig. 2.

Chætodon rafflesi BENNETT, Life of Raffles (1830) 689; GÜNTHER, Cat. Fishes 2 (1860) 27; Fische der Südsee 1 (1877) 44, pl. 35, fig. 2; PETERS, Monatsber. Akad. Wiss. Berlin (1876) 832; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 339; AHL, Chaetodontidae, 158, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus rafflesi BLEEKER, Atlas Ichth. 9 (1878) 49, pl. 376, fig. 4.

Chætodon princeps CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 25.

Chætodon sebae CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 40.

Dorsal XIII (rarely XIV), 22 or 23; anal III, 19 or 20; there are 29 or 30 scales in a lateral series, 7 between the lateral line and the origin of dorsal, and 14 between the lateral line and the origin of anal.

The strongly compressed body very deep, the back very much elevated with the anterior profile from interorbital space to origin of dorsal very steep; the depth of body 1.6 to 1.7 times in length; the head pointed, a little longer than deep, 2.9 to 3.1 times in length of body, its dorsal outline concave, the depth of caudal peduncle contained from 5.2 to 5.8 times in that of body; the interorbital space little convex, 3.5 to 3.9 times in length of head and about as wide as preorbital, which is contained 3.5 to 4.2 times and a little narrower than the circular eye, which is high up, near profile of head and almost midway between tip of snout and posterior edge of opercle; the snout produced, conical, and longer than eye, 2.4 to 2.8 times in length of head; the maxillary short and 3.5 to 3.9 times in head; the mouth small and horizontal, the jaws about even; the two nostrils close together in front of eye, the anterior one circular and provided with a fleshy rim, the other one an oblique slit pointing upward and backward toward upper rim of orbit and having a wide fleshy flap below; the preopercle distinctly serrated at the angle.

The scales large on side of trunk, becoming smaller on head, vertical fins, and caudal; the strongly arched lateral line terminates at the fourth to the sixth scale in front of axil of dorsal fin; the dorsal spines are graduated in height to the last, which is 1.3 to 1.7 times in head; the third anal spine longer than second and about as long as last dorsal; the rayed portions of vertical fins rounded posteriorly; the caudal slightly convex; the pectoral rather broad, shorter than head, and 1.8 to 2.2 times in depth of body, its tip above anus; the ventral fin is pointed and extends to anus, its spine about as long as third anal or last dorsal spine.

In life the ground color is deep lemon yellow; the trunk is checkered with two series of cross streaks on the edges of the scales, which are pinkish brown above and pinkish red below; the forehead grayish; the head bright lemon yellow on each side of the black ocular band, which descends from origin of dorsal to inferior margin of interopercle; the soft dorsal is edged with lemon yellow and has a submarginal band of black, bordered in front with another submarginal band of yellow, which is separated from the lemon yellow color of fin by a reddish area; the anal is lemon yellow at its edge and has a fine submarginal line of black; within this line the color of the fin changes from orange yellow to bright lemon yellow; the caudal bright lemon yellow, traversed by a black band which is widest along the middle, and edged posteriorly with gray; the pectoral and ventral bright lemon yellow.

In alcohol the ground color varies from yellowish to yellowish brown, becoming darker above toward dorsal; the oblique streaks on each side of body, which cross each other, are gray; black bands on head, caudal, and soft dorsal very distinct, the band on the last fin edged on both sides with yellowish, and the remaining portion grayish; the anal is yellowish at edge and has a blackish submarginal line; the caudal yellowish and edged with grayish behind; both pectoral and ventrals yellowish.

There are twenty-four examples in the Bureau of Science collection, which were obtained at the following localities: Aloneros, Tayabas; Calapan, Mindoro; Tagbilaran, Bohol; Canigaran, Palawan; southern coast of Cotabato Province, Mindanao; and Tubigan Island, Sulu Archipelago. One of the three specimens from Aloneros, 114 millimeters in length, is a female about ready to spawn, collected in December, 1925.

This species, which hitherto has not been reported from the Philippines, occurs throughout the East Indies, extending northeastward to the Pelew Islands and southeast to the Bismarck Archipelago and Fiji.

CHÆTODON MODESTUS (Schlegel).

Chætodon modestus SCHLEGEL, Fauna Jap., Poiss. (1842) 80, pl. 41, fig. 2; GÜNTHER, Cat. Fishes 2 (1860) 10; JORDAN and FOWLER, Proc. U. S. Nat. Mus. 25 (1902) 535; SEALE, Philip. Journ. Sci. § D 9 (1914) 72; AHL, Chaetodontidae, 82, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Coradion modestum JORDAN, TANAKA, and SNYDER, Cat. Fishes Japan, Journ. Coll. Sci. Imp. Univ. Tokyo 23 (1913) 211, fig. 213.

Coradion desmotes JORDAN and FOWLER, Proc. U. S. Nat. Mus. 25 (1902) 539, fig. 5.

Dorsal XI, 22; anal III, 19; there are about 46 scales in a lateral series, 11 between the lateral line and the origin of dorsal, and 27 between the lateral line and the origin of anal.

The body very short, deep, and compressed, the back strongly elevated; the depth contained 1.5 times in length; the pointed head about as long as deep, 2.5 times in length of body and 2.8 times the depth of the short, deep caudal peduncle, its upper profile steep; the convex interorbital as wide as length of maxillary, which is 3.5 times in length of head; the circular eye rather large and midway between tip of snout and posterior margin of opercle, its diameter 3 times in head or a little shorter than the produced pointed snout, which is contained 2.8 times; the preorbital a little narrower than length of maxillary and a trifle more than two-thirds eye; the mouth small; the small nostrils close together and a little before eye, the front one circular and having a high fleshy flap behind, the other a simple oval opening; the posterior edge of preopercle distinctly serrated.

The scales small on side of body and very small on head, vertical fins, and caudal; the lateral line is strongly arched, nearly concurrent with margin of dorsal, and forms a blunt angle below base of anterior dorsal rays, its posterior end a little in front of axil of dorsal fin; the dorsal spines decrease in height posteriorly from third, which is as long as head; the second anal spine stronger and higher than third, being 1.5 times in head; both soft dorsal and anal very broadly rounded; the caudal fin truncate; the pointed pectoral shorter than head and 1.4 times in depth of body, its tip above origin of anal; the ventral fin is longer than pectoral and extends to base of anal spines, its spine 1.4 times in head.

The ground color in alcohol yellowish brown; a black ocular band about as wide as eye descends from origin of dorsal to inferior margin of interopercle; a narrow black band runs from supraoccipital region to tip of snout; on each side of trunk two rather broad, dark-edged, brown vertical bands, the first one a little shorter than pectoral, descending from the spinous dorsal toward belly; the other one of about equal width from soft dorsal to soft anal; the anterior portion of rayed dorsal has a white-edged black ocellus, which is about the size of eye; the ventrals blackish, both pectoral and caudal fins yellowish brown.

Here described from a single specimen, 35.5 millimeters long, collected by Alvin Seale at Hongkong.

This species is only known to occur in the Chinese and Japanese seas, but may occur among the Batan and Babuyan Islands and along the north coast of Luzon.

CHÆTODON OCTOFASCIATUS Bloch.

Chætodon octofasciatus BLOCH, Ichtyologie 6 (1788) 85, pl. 215, fig. 1; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 13; GÜNTHER, Cat. Fishes 2 (1860) 17; DAY, Fishes of India (1878) 108; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1906) (1907) 96;

AHL, Chaetodontidae, 84, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Tetragonoptrus octofasciatus BLEEKER, Atlas Ichthy. 9 (1878) 38, pl. 376, fig. 3.

Dorsal XI, 18 to 20; anal III, 16 or 17; there are 45 to 48 scales in a lateral series, 12 between the lateral line and the origin of dorsal, and 21 between the lateral line and the origin of anal.

The body very deep, strongly compressed and subcircular, the depth 1.3 to 1.5 times in length, the back a little more elevated than the ventral outline; the head shorter than deep, 3.2 to 3.4 times in length of body, its upper profile very steep and nearly straight; the depth of the small caudal peduncle 7.6 to 9.2 times in length of body; the interorbital space strongly and evenly convex, rather broad, 2.7 to 3.1 times in head; the eye circular and moderate in size, 2.5 to 3 times in length of head; the obtuse and bluntly rounded snout 2.8 to 3.1 times in head and longer than maxillary, which is contained 3 to 4.6 times; the width of preorbital behind maxillary 1.4 times in diameter of eye; the mouth small, oblique, the jaws equal; the two nostrils before each eye rounded and close together, the one in front having a fleshy rim, highest around the posterior portion, the nostril behind a simple opening; the preopercle finely serrated behind and below.

The scales on side of body small and in nearly vertical series, those covering head, vertical fins, and caudal very small; the lateral line is moderately arched and terminates at the sixth to the eighth scale in front of axil of dorsal fin; the middle dorsal spines higher than the posterior ones, the second anal spine about as high as the third, which is 2.6 to 3.2 times in head; the soft portions of dorsal and anal very broadly rounded; the caudal fin convex; the short broad pectoral a little shorter than head, being 2.5 to 3.1 times in depth of body and ending above anus; the ventral fin extends to base of first anal spine, its spine 2.7 to 3.2 times in head.

In life the ground color is bright lemon yellow, paler along breast and belly; on each side eight blackish brown transverse bands with wider spaces between second and third, fourth and fifth, sixth and seventh, so that they appear to be arranged in pairs; the first of these bands crosses eye and the last one is on caudal fin; a blackish brown longitudinal band runs from tip of snout to nape of neck; the portion of seventh band which crosses caudal peduncle edged in front and behind with white;

the soft dorsal and anal have a blackish brown band near margin, edged on each side with white; the pectoral and the outward portion of tail pale, the ventral lemon yellow; in younger specimens a large blackish blotch is below the lateral line between the fourth and fifth bands.

In alcohol the ground color is brownish, fading into yellowish on breast and belly; the bands turn to blackish violet.

Here described from twelve specimens, 57 to 78.5 millimeters long, collected at the following places: Sisiman, Bataan Province; Estancia, Panay; and Basbas Island, Sulu Archipelago. The largest of the specimens is a ripe female, collected February 11, 1925. This species has been recorded previously in the Philippines by Evermann and Seale from Bacon, Sorsogon.

This easily recognized fish is known to occur only in the seas of India and the East Indian Archipelago to the Moluccas.

CHÆTODON COLLARE Bloch.

Chætodon collare BLOCH, Ichtyologie **6** (1787) 87, pl. 216, fig. 1; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 41; AHL, Chaetodontidae, 135, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Chætodon collaris KNER, Reise Novara, Fische (1865) 99; SEALE, Philip. Journ. Sci. § D **9** (1914) 72.

Tetragonoptrus collaris BLEEKER, Atlas Ichthy. **9** (1878) 42, pl. 373, fig. 2.

Chætodon praetextatus CANTOR, Cat. Malayan Fishes, Journ. Roy. Asiatic Soc. Bengal **18** (1849) 156, pl. 3; GÜNTHER, Cat. Fishes **2** (1860) 22; DAY, Fishes of India (1878) 107, pl. 27, fig. 6.

Chætodon viridis BLEEKER, Nat. & Gen. Arch. Ned. Ind. **2** (1845) 520.

Dorsal XII, 26 to 28; anal III, 20 to 22; scales in the lateral line 34 to 38; from the lateral line to the origin of dorsal 6 or 7, to the origin of anal 15 to 18.

The depth of the orbiculate subrhomboid body twice or nearly twice, and the head 4 or nearly 4 times in length; the dorsal profile concave; the eye 2⅓ to 3 times in head, the interorbital nearly or quite equal to eye; the snout without maxilla shorter than eye; the preorbital smooth, the preopercle not or scarcely denticulate; the anterior lateral scales of medium and nearly uniform size, those posteriorly along middle sensibly smaller; the soft dorsal obtusely rounded, the middle rays longer than the others; the anal also obtusely rounded, shorter than the dorsal rays; the caudal truncate-convex.

The color of body violaceous to yellowish green; the head has two violet-brown to blackish crossbars, one before eye back of mouth, the other an ocular band; they are over a white background which stands out in strong contrast as white bands between and behind the dark bars; between the rows of scales on the sides is a deep green or violet-green stripe, running obliquely upward and backward; the scales at sides of dorsal and anal bases each with a yellow or golden spot; the spinous dorsal and pectoral yellowish to rosy; the ventrals purple to blackish; the free parts of soft dorsal and anal and basal half of caudal carmine; the soft dorsal has a white, dark-margined, longitudinal stripe; the anal has a white marginal band, its inner side fuscous; the posterior half of caudal has a dark purple crossband, beyond which is a pearly white border, the posterior margin of the fin with a wide yellow band.

The above description is taken from Bleeker. In 1924 a beautiful specimen of this fish was brought from Calapan, Mindoro, and kept alive a long time in the Bureau of Science aquarium. Unfortunately the fish died during our absence from Manila, and the specimen was not preserved.

This species, either the typical form or some of its varieties, occurs from the coast of India to Celebes, and north to China.

CHÆTODON ORNATISSIMUS (Solander). Plate 9, fig. 1.

Chætodon ornatissimus Solander in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 17; GÜNTHER, Cat. Fishes 2 (1860) 15; Fische der Südsee 1 (1873) 38, pl. 30, fig. B; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 373, pl. 53; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 345; AHL, Chaetodontidae, 51, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus ornatissimus BLEEKER, Atlas Ichth. 9 (1878) 32, pl. 375, fig. 2.

Dorsal XII, 25 or 26; anal III, 21; there are about 50 scales in a lateral series, 10 between the lateral line and the origin of dorsal, and 21 or 22 between the lateral line and the origin of anal.

The body very deep, compressed, and contained 1.5 times in length; the head very deep, much deeper than long, its length 3.1 to 3.5 times in length of body, and its upper profile almost straight from tip of snout to origin of dorsal fin; the caudal peduncle much compressed and deeper than long, its depth 8.1 times in length of body or 2.3 times in length of head; the interorbital space broad, strongly convex, as wide as length of maxillary which is contained 2.9 to 3.1 times in head; the eye circular, placed rather high, and located about halfway between tip of snout and posterior edge of opercle, its diameter 3.4 to 3.5 times in head; the snout bluntly rounded, rather short, 2.7 in head or a little longer than maxillary; the mouth small, with the terminal jaws slightly produced and the lips somewhat thin and broad; the width of preorbital at angle of mouth slightly more than half the eye; the suborbital ring is a little narrower and appears to be adnate to the cheek; the preopercle finely serrated; there are two nostrils, close together, the anterior one circular and provided behind with a fleshy flap, the posterior one oval and slightly oblique; the opercle entire, provided posteriorly with two blunt flat spines.

The scales moderate, in regular horizontal and vertical series, those on vertical fins and top of head very small; the lateral line strongly arched, somewhat angular below anterior third of rayed dorsal and not continued beyond base of last dorsal rays; the dorsal spines increase in height to the last, which is 1.3 to 1.7 times in head; the soft dorsal more rounded than the rayed anal; the caudal fin convex; the pectoral slightly pointed inferiorly, rather short, 3.4 times in length of body and slightly shorter than head, its posterior end above anus; the ventral fin barely extends to anus, with the spine 1.6 to 1.8 times in head or slightly shorter than third anal spine.

The ground color in alcohol yellowish brown, with six broad, oblique, orange or brownish bands on each side of body running upward and backward and alternating with whitish; the head crossed by blackish vertical bands, the anterior two of which are broad, the first one running from snout to chin and the other from above occiput, through eye, to breast; the lower lip broadly blackish; two narrow blackish vertical bands behind eye, one continued from across posterior portion of preopercle up along margin of dorsal to the last dorsal rays, and the other across anterior portion of opercle; a broad band of grayish brown almost wholly covering the interorbital space; the spaces between the blackish bands on head yellowish; the rayed vertical fins narrowly edged with blackish, the anal having a submarginal band of similar color running parallel with margin of fin; two blackish crossbands on caudal fin, which is edged with white posteriorly; both pectoral and ventral fins yellowish.

This large and very handsome fish is here described from five specimens in the Bureau of Science collection, measuring 21 to 114 millimeters in length, three of which are ripe females; one was collected February 15, 1925, at Balinakan, Marinduque, and two were collected March 26, 1926, at Bennett Island, Masbate. The other two specimens were collected at Quiminatin Island, Cuyo Islands. The first record of this species in the

Philippines is by Jordan and Seale, who had one specimen, purchased in the Manila market.

The species is known from the Moluccas to Samoa and Tahiti, northward to Hawaii.

CHÆTODON MELANOTUS Bloch and Schneider. Plate 11, fig. 2.

Chætodon melanotus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 224; GÜNTHER, Fische der Südsee 1 (1873) 44; DAY, Fishes of India (1878) 108, pl. 28, fig. 1; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 341; AHL, Chaetodontidae, 128, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus melanotus BLEEKER, Atlas Ichth. 43 (1878) pl. 376, fig. 1.

Chætodon dorsalis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 53; RÜPPELL, Atlas, Fische des Rothen Meers (1828) 41, pl. 9, fig. 2; GÜNTHER, Cat. Fishes 2 (1860) 28.

Chætodon marginatus (Ehrenberg) CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 44.

Chætodon abhortani CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 44.

Dorsal XII, 19 or 20; anal III, 17 or 18; there are 36 to 40 scales in a lateral series, 8 or 9 between the lateral line and the origin of dorsal, and 17 between the lateral line and the origin of anal.

The body very deep and strongly compressed, with the dorsal and ventral profiles about equally elevated; the depth contained from 1.6 to 1.7 times in length; the head, which is pointed, is as long as deep, 3.1 to 3.4 times in length of body, its dorsal profile very slightly concave; the depth of caudal peduncle 8.4 to 9.6 times in length of body; the evenly convex interorbital fairly wide, 2.8 to 3.1 times in head; the large circular eye superior and closer to tip of snout than to vertical line through posterior margin of opercle, its diameter 2.8 to 3.4 times in length of head, or shorter than the long pointed snout which is contained 2.7 to 3 times; the maxillary 3.4 to 4.3 times in head, slightly longer than width of maxillary behind it, which is greater than two-thirds eye; the mouth small, its gape horizontal, the jaws about even; the two nostrils in front of each eye are close together, the one in front circular and provided with a fleshy rim which is highest behind, the other a simple slit covered above by an overhanging portion of the skin; the preopercle indistinctly serrated at the angle.

The scales covering the sides are large and in almost vertical series, those on head, vertical fins, and caudal very small; the lateral line is deeply arched and ends below posterior third of dorsal fin; the fifth and sixth dorsal spines highest, each being 1.3 to 1.5 times in head; the second anal spine higher and stronger than third anal; both rayed dorsal and anal broadly rounded; the caudal truncate; the short broad pectoral is 2 to 2.4 times in depth of body and does not quite extend to above anus; the ventral fin extends almost to anus, its spine 1.2 to 1.7 times in head.

In life the color is bright yellow or bluish gray, with the snout bright lemon yellow; a broad blackish patch covers the whole back and incloses one or two small whitish blotches which may be absent in some specimens; the scales on each side of trunk have dusky rows of blackish spots which run upward and backward, the upper ones forming closely spaced stripes, those below more or less separated; a blackish ocular band, narrower than eye, which runs from nape to breast, is edged with bright yellow on both sides; a large black blotch superiorly on caudal peduncle and a much smaller one, which may be absent in some individuals, exists below; in the young a large black blotch entirely covers caudal peduncle; the spinous dorsal brownish yellow; the soft dorsal blackish brown at base, and bright yellow on the remaining portion, with a submarginal line of black; the anal fin broadly bright yellow, with a clear yellow edge and a submarginal line of black; the caudal is yellow toward base, translucent posteriorly, and has a blackish vertical streak; the pectoral colorless and the ventrals golden yellow.

In alcohol the light areas on head, body, and fins become yellowish brown, with the exception of the pectoral and the outward portions of the soft vertical fins and caudal, which are almost transparent; the dark portions blackish violet.

In the Bureau of Science collection are thirty-one examples which range from 17 to 137 millimeters in length. They were obtained at the following localities:

Mariveles, Bataan, 1.
Southern coast of Batangas Province, a ripe female, 126.5 millimeters long, collected March 15, 1925.
Calapan, Mindoro, 8.
Tagapula Island, Samar, 1.
Gigantangan Island, Leyte, 1.
New Washington, Capiz, 2.
Bantayan Island, 1.
Cebu, Cebu, 4.
Agutaya and Quiminatin Islands, Cuyo Islands, 2.
Zamboanga, Mindanao, 1.
Sibutu Island, Sulu Archipelago, 10.

The species, which hitherto has not been reported from the Philippines, occurs from the Red Sea and the east coast of

Africa, through the seas of India and East Indies to Fiji and Samoa, extending northward to the coast of China.

CHÆTODON ULIETENSIS Cuvier and Valenciennes.

Chætodon ulietensis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 30; GÜNTHER, Cat. Fishes 2 (1860) 18; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 340; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1907) 96; AHL, Chaetodontidae, 171, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus ulietensis BLEEKER, Ned. Tijd. Dierk. 1 (1863) 234.

Chætodon falcula (not of Bloch) GÜNTHER, Fische der Südsee 1 (1873) 39, pl. 27, fig. C; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1906) (1907) 96.

Chætodon aurora DE VIS, Proc. Linn. Soc. N. S. Wales 9 (1884) 453.

Dorsal XII, 23; anal III, 20; there are 31 scales in a lateral series, 7 between the lateral line and the origin of dorsal, and 15 between the lateral line and the origin of anal.

The body very deep and much compressed, its depth 1.6 times in length, the back much elevated and evenly arched; the head longer than deep, 2.9 times in length, its upper profile convex; the depth of the short, compressed caudal peduncle 9.3 times in length of body or 5.8 times in its depth; the interorbital evenly convex and rather wide, as wide as the circular eye which is 3.8 times in length of head; the long snout pointed, conical, and 2.2 times in head; the maxillary contained 3.6 times in head; the preorbital wider than eye, 3.2 times in length of head; the mouth small, its gape almost horizontal, jaws equal; the two small nostrils close together in front of eyes, the anterior one circular and provided with a high flap behind, the other a simple slit which is nearly horizontal; both the inferior and the posterior edges of preopercle finely denticulated.

The scales on side of body moderately large and in regular oblique series, those on head and fins becoming very small; the lateral line is slightly arched and ends below anterior third of the rayed dorsal; the dorsal spines moderately high, the last one the highest and contained 1.6 times in head, the third anal spine about as high as last dorsal spine; the soft portions of vertical fins rounded; the caudal a little convex; the pectoral 1.4 times in head, pointed and longest superiorly, its tip a little before vertical passing through anus; the ventral just reaches anus, its spine a little longer than either last dorsal or third anal spine.

In alcohol the ground color yellowish brown; about sixteen almost vertical blackish violet lines on each side of trunk; the blackish violet ocular band is about as wide as eye and descends from back of nape to lower edge of interopercle; a very broad blackish violet vertical band crosses anterior portion of trunk from anterior half of spinous dorsal to behind pectoral base; a second vertical band on body descends from posterior portion of spinous dorsal and from anterior part of rayed portion to or nearly to anal; the caudal peduncle covered with a blackish violet blotch; a narrow blackish edge on soft dorsal; the caudal has a white and black edge posteriorly; the soft anal has two submarginal blackish lines; the pectoral and ventral fins uniformly yellowish brown.

The Bureau of Science collection has but a single specimen, 126 millimeters long, collected at Olongapo, Zambales. This species, which has been reported in the Philippines from Bacon, Sorsogon, by Evermann and Seale, occurs from the Moluccas eastward throughout the South Sea Islands.

CHÆTODON LINEOLATUS Quoy and Gaimard. Plate 10, fig. 2.

Chætodon lineolatus Quoy and Gaimard in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 31; QUOY and GAIMARD, Voy. Astrolabe (1835) 381; GÜNTHER, Cat. Fishes 2 (1860) 30; Fische der Südsee 1 (1873) 45, pl. 34, fig. A; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 365, fig. 159; AHL, Chaetodontidae, 167, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Chætodon lunatus Ehrenberg in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 43; RÜPPELL, Neue Wirbelt. Abyssinien, Fische (1835) 30, pl. 9, fig. 3.

Chætodon oxycephalus BLEEKER, Nat. Tijd. Ned. Ind. 4 (1853) 603; GÜNTHER, Cat. Fishes 2 (1860) 27.

Chætodon tallii Bleeker, Nat. Tijd. Ned. Ind. 6 (1854) 97; GÜNTHER, Cat. Fishes 2 (1860) 11.

Tetragonoptrus lineolatus BLEEKER, Atlas Ichth. 9 (1878) 51, pl. 377, fig. 2.

Dorsal XII, 24 to 27; anal III, 19 to 22; there are 28 to 30 scales in a lateral series, 7 or 8 between the lateral line and the origin of dorsal, and 16 or 17 between the lateral line and the origin of anal.

The body very deep, compressed, its depth 1.5 to 1.7 times in length, its dorsal profile much elevated; the head about as long as deep, 3 to 3.1 times in length of body, the upper profile from tip of snout to origin of dorsal strongly concave; the caudal peduncle very short and deep; its least depth 8.4 to 9.6 times in greatest depth of body; the broad, strongly convex interorbital 3.3 to 3.7 times in length of head, and approximately as wide as the length of maxillary which is contained 3 to 3.5 times; the small circular eye about halfway between tip of snout and posterior margin of opercle, 3.6 to 4.8 times in head; the snout much produced, somewhat conical and nearly horizontal, its length greater than twice diameter of eye, 2.1 to 3 times in length of head; the width of preorbital behind maxillary slightly greater than that of interorbital, and contained from 3.1 to 3.2 times in head; the mouth small, nearly horizontal, with the slightly produced jaws about even; there are two nostrils, close together in front of each eye, each margined by a fleshy flap, the more anterior small, circular, and with the flap behind rather high, the posterior nostril an oblique slit; the preopercle serrated behind and below.

The scales on sides very large and in regular, very oblique series, those on head, chest, caudal peduncle, and bases of rayed vertical fins becoming smaller, and those covering the soft dorsal and anal very small; the lateral line is very slightly arched and ceases below posterior dorsal spines; the dorsal spines increase in height to the last, which is contained 1.6 to 2 times in length of head as is likewise the third anal spine; both the soft dorsal and anal angular posteriorly; the caudal fin slightly convex; the pectoral, which is pointed and longest superiorly, is 2.3 to 2.7 times in height of body and extends to above anus; the ventral barely reaches anus, its spine is longer than either last dorsal or third anal spine, 1.8 to 2.2 times in head.

The ground color in alcohol varies from yellowish to yellowish brown; the body crossed by fine blackish vertical lines, one along lower posterior margin of each series of scales; a black ocular band, wider than eye, descends from occiput to lower edge of interopercle, crossing side of head; above eye it divides and incloses a triangular light area; in very young examples this light portion forms part of the yellowish area in front of head and in older forms it connects with the ground color of body, dividing the ocular band into two; a broad blackish band, widest anteriorly, extends along base of soft dorsal, across caudal peduncle, and in very large individuals extends to or upon the base of anal rays; the soft dorsal has a median blackish longitudinal line; the dorsal and anal rays narrowly edged with blackish; the caudal fin is narrowly edged behind with gray, and has a wider submarginal band of blackish; the pectoral and ventral colored similarly to body.

This large species, which reaches a length of 300 millimeters, is described from twenty-seven specimens, ranging from 32 to

227 millimeters in length. They were collected at Ambil Island; southern coast of Batangas Province; Maricaban Island; Calapan and Bulalacao Bay, Mindoro; Elefante Island, Marinduque; Bennett Island, Masbate; Tagapula Island, Samar; Gigantangan Island, Leyte; Cebu, Cebu; Quiminatin Island, Cuyo Islands; and Sibutu and Sitankai Islands, Sulu archipelago. The two specimens from Ambil Island, 167 and 177 millimeters in length, are ripe male and female, collected August 28, 1925.

This species, which is here recorded for the first time from the Philippines, ranges from the Red Sea and the east coast of Africa, through the Malay Archipelago, southeastward to the Society Islands, and northward to the Hawaiian Islands.

CHÆTODON BELLA-MARIS Seale. Plate 17, fig. 1.

Chætodon bella-maris SEALE, Philip. Journ. Sci. § D **9** (1914) 72, pl. 1, fig. 1; AHL, Chaetodontidae, 112, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Dorsal XII, 24; anal III, 18; there are 34 scales in a lateral series, 9 between the lateral line and the origin of dorsal, and 14 between the lateral line and the origin of anal.

The body very deep and strongly compressed, with the back much elevated and the anterior dorsal profile from tip of snout to origin of dorsal very steep and nearly straight; the depth 1.6 times in length; head, which is about as long as deep, contained 3.2 times in length of body; the depth of caudal peduncle 2.4 times in length of head or 9 times in that of body; the interorbital prominently convex and contained 3 times in head; the eye large and circular, its diameter 3.2 times in head; the snout longer than either diameter of eye or width of interorbital, and 2.7 times in length of head; the maxillary, which is shorter than eye, is contained 3.4 times in head and ends posteriorly below anterior nostril; the width of preorbital behind maxillary slightly more than two-thirds eye; the mouth fairly small and the jaws even; the two nostrils in front of each eye small and close together, the anterior one circular and having a fleshy rim which is highest behind, the other an oval slit provided with a low marginal fleshy flap; the preopercle serrated on its outer edges.

The scales on each side of body large and in regular oblique series, those on head, vertical fins, and caudal very much smaller; the strongly elevated lateral line ascends upward and backward nearly to base of posterior dorsal spines in almost a straight line, and descends backward and downward, ending before axil of dorsal; the dorsal spines evenly graduated to the last, which is the longest, 1.5 times in head; the second and third anal spines of nearly the same height, each approximately 1.5 times in head; both the rayed dorsal and anal slightly rounded; the caudal fin almost truncate; the pectoral is as long as head and ends above anus; the ventral extends past anus, its spine 1.8 times in head.

According to Seale the color in life is yellowish; a black ocular band, margined with white, which is slightly wider above than eye, is continuous above with the opposite band and extends below to lower margin of subopercle; the snout yellow, tip of upper jaw black; a large, black, wedge-shaped mark present on shoulder from spinous dorsal to the white border of the ocular band, this black area having a narrow black prong extending from its posterior margin to upper tip of opercle; the dorsal narrowly edged with black and the anal with brown; the caudal fin is tipped with white and has a wide submarginal band of black; there are twelve to fourteen rather wide, indistinct, brownish lines running obliquely forward and downward on the rows of scales; the ventrals and pectoral yellowish.

In alcohol the ground color is yellowish, the black markings have become deep brown, and the oblique lines on each side of body are yellowish brown; the brownish marginal line on anal has faded into the ground color.

The above account was taken from the type and only specimen in the Bureau of Science collection. It measures 132 millimeters in length and was collected by Seale in the Hongkong market in 1910.

Ahl had specimens from Takao, Formosa, Hongkong, and Canton. He states that the young of this species are extraordinarily similar to *Chætodon lunula* and *C. fasciatus*. In his specimens he found the following variations: Dorsal XII, 23 to 26; anal III, 19 to 22; lateral line, 37 to 40; scales in transverse series 7 to 12.

CHÆTODON ADIERGASTOS Seale. Plate 15, fig. 1.

Chætodon adiergastos SEALE, Philip. Journ. Sci. § D 5 (1910) 116, pl. 1, fig. 2; AHL, Chaetodontidae, 112, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5 (after Seale).

Dorsal XII, 23 to 26; anal III, 20; there are 32 scales in a lateral series, 9 between the lateral line and the origin of dorsal, and 15 between the lateral line and the origin of anal.

The short deep body strongly compressed, the predorsal region and back much elevated, the depth 1.3 to 1.4 times in length; the small pointed head 2.8 to 3.2 times in length of body, its upper profile steep and concave, the interorbital space slightly convex; a more or less decided hump between head and origin of dorsal; the small, pointed, but rather broad snout 2.8 to 3.2 times in head; the large circular eye approximately equal to snout, 2.7 to 3.2 times in head and slightly greater than interorbital, which is contained 3 to 3.8 times; the maxillary 3.5 to 3.7 times in head; the preorbital more than half as wide as eye; the mouth small, with horizontal gape and equal jaws; the two small nostrils close together in front of each eye, the first one circular and provided with a fleshy rim which is higher posteriorly, the other oval and having a marginal flap; the preopercle finely serrated behind, and coarsely serrated at the angle and below.

The scales large on sides of body and small on head, vertical fins, and caudal; the lateral line very strongly elevated, rather straight in front and arched posteriorly to below base of fourth ray from axil; the middle dorsal spines stronger and higher than the posterior ones; second anal spine almost as long as third, which is contained 1.4 to 1.5 times in length of head; both soft dorsal and anal rounded; the caudal truncate; the pointed pectoral is slightly shorter than head and ends behind vertical through anus; the ventral extends beyond anus; its spine 1.6 to 1.9 times in head.

The ground color in alcohol yellowish brown; each side of body has numerous deep brown lines running obliquely downward and forward, each line passing through the middle of each row of scales; the black ocular band, wider than eye, ends below at lower edge of interopercle and is not united above with its fellow or with the very small black saddle on nape; the anterior two-thirds of soft dorsal and anal are edged with blackish and have a submarginal band of yellowish; the caudal fin has near its outer edge a blackish vertical band, which is bordered with yellowish in front and behind; the pectoral a little dusky and the ventral yellowish.

Here described from twenty-seven specimens, 79 to 125 millimeters long, coming from the following localities:

Mariveles, Bataan, 3 ripe females, 115 to 123 millimeters long, collected April 22, 1922.

Hamilo, Batangas, 4 specimens, each 119 millimeters long, one of them a ripe female, collected April 22, 1922.

San Miguel Bay, Camarines Sur, 1.

Calapan, Mindoro, 6.

Inabanga and Guindulman, Bohol, 2.
Gigantangan Island, Leyte, 1.
Carnasa, Island, Leyte, a ripe female, 115 millimeters long, collected in February, 1925.
Bantayan Island, 2.
Buenavista, Guimaras, 4.
Guiminatin Island, Cuyo Islands, 2.
Bungau Island, Sulu Archipelago, 1.

Seale had two specimens, both collected by Dr. Lawrence E. Griffin at Bantayan Island. Both have disappeared from the Bureau of Science collection. Seale's type was 116 millimeters in length.

CHÆTODON FASCIATUS Forskål. Plate 9, fig. 2.

Chætodon fasciatus FORSKÅL, Descr. Anim. (1775) 59, No. 80; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 47; GÜNTHER, Cat. Fishes 2 (1860) 24; AHL, Chaetodontidae, 117, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.
Tetragonoptrus fasciatus BLEEKER, Atlas Ichth. 9 (1878) 41, pl. 374, fig. 2.
Pomacentrus lunula LACÉPÈDE, Hist. Nat. Poiss. 4 (1803) 507, 510, 513.
Chætodon lunula CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 45, pl. 173; GÜNTHER, Cat. Fishes 2 (1860) 25; Fische der Südsee 1 (1873) 42, pl. 33; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 366, pl. 54 and fig. 160; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 340.
Chætodon flavus RÜPPELL, Atlas Fische (1828) 40, pl. 9, fig. 1.
Chætodon biocellatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 48 (young); GÜNTHER, Cat. Fishes 2 (1860) 9.
Chætodon wiebeli KAUP, Nat. Tijd. Dierk. 1 (1863) 126.

Dorsal XII, 23 to 25; anal III, 18 or 19; there are 34 to 38 scales in a lateral series, 9 between the lateral line and the origin of dorsal, and 16 between the lateral line and the origin of anal.

The body very deep and compressed, its depth 1.5 to 1.7 times in length and its dorsal profile much more elevated than the ventral; the head about as long as deep, 2.8 to 3.1 times in length of body, its upper profile from tip of snout to origin of dorsal fin very slightly concave; the caudal peduncle very short and deep, its least depth 8.7 to 9.3 times in length of body or 5.3 to 6 times in depth; the broad interorbital space 3.5 to 4 times in length of head or approximately as wide as length of maxillary, which is contained 3.5 to 3.9 times; the circular eye halfway between tip of snout and vertical passing through posterior margin of opercle, 2.9 to 3.6 times in length of head; the snout slightly produced and longer than eye, 2.5 to 2.7 times in head; the width of preorbital behind maxillary nearly equal to eye; mouth small, with the jaws a little produced and about even; the two nostrils in front of eye close together, the one in front circular and provided with a rather high fleshy flap posteriorly, the other more of an oblique slit with a low marginal flap; the margins of preopercle serrated.

The scales on side of body in regular oblique series and rather large, those toward fins becoming very small; the lateral line strongly arched and not continued beyond base of posterior dorsal rays; the middle dorsal spines about as high as posterior ones, the last dorsal spine 1.5 to 1.9 times in length of head; the second and third anal spines equal and longer than last dorsal spine; both the rayed vertical fins broadly rounded; the caudal broad and convex; the broad and slightly rounded pectoral is about twice length of snout and ends just above anus; the pointed ventral extends a little beyond it, its spine shorter than third anal.

The life colors of a specimen collected by R. C. McGregor in Guam were as follows: The ground color was yellow; the shoulders were dusky; there was a wide vertical black band across eye, and the space between this and the dusky shoulder was white; the caudal peduncle was black; there was a white-margined black band near base of soft dorsal; the vertical fins were edged with dusky; the body had brownish orange lines obliquely descending forward.

The ground color in alcohol is yellowish brown, with blackish brown bands running downward and forward; the black ocular band, which is wider than eye, unites on interorbital space with its fellow and terminates below at lower edge of preopercle; a broad black band edged behind with white runs from gill opening above base of pectoral to base of middle dorsal spines and appears to unite with another black band, which covers base of anterior dorsal spines and extends to origin of fin; a third black band is situated between the last-mentioned two and is broadly edged with white; a white-edged black band runs along base of soft dorsal and widens out toward caudal peduncle which it covers; the vertical fins are margined with black; the caudal fin has a whitish margin and a submarginal band of black; the other fins are yellowish. In the young the black band along anterior portion of trunk appears as a large triangular blotch and the space between it and the ocular band is milk white; there is a round white-edged black ocellus along middle of soft dorsal fin.

The above description is based upon a study of nine specimens, 51 to 157 millimeters long, from the following localities: Currimao, Ilocos Norte; Balaoan, La Union; Manila Bay; Monja Island, off the entrance to Manila Bay; the southern coast of Batangas Province; Calapan, Mindoro; Cebu, Cebu; and the southern coast of Cotabato Province. Our largest example, collected in Batangas Province March 15, 1925, is a ripe female.

This very beautiful species, not hitherto recorded from the Philippines, has an enormous range, occurring from the Red Sea throughout the Indian Ocean and Malay Archipelago, northward to China, and eastward to Hawaii and the Marquesas. It presents such wide variations in coloration that we do not hesitate to regard *Chætodon fasciatus* Forskål as identical with the present species.

CHÆTODON SELENE Bleeker. Plate 10, fig. 1.

Chætodon selene BLEEKER, Nat. Tijd. Ned. Ind. 5 (1853) 76; GÜNTHER, Cat. Fishes 2 (1860) 30; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1907) 96; AHL, Chaetodontidae, 119, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus selene BLEEKER, Atlas Ichthy. 9 (1878) 44, pl. 377, fig. 5.

Dorsal XII, 20 to 22; anal III, 18 or 19; there are 28 to 32 scales in a lateral series, 9 between the lateral line and the origin of dorsal, and 14 between the lateral line and the origin of anal.

The body very deep and much compressed, the back more strongly elevated than the ventral, and the anterior dorsal profile very steep; the depth of body 1.6 to 1.7 times in length; the head nearly as long as deep, 3 to 3.2 times in length of body, the anterior upper profile very slightly concave; the depth of the short, compressed, caudal peduncle contained 8.8 to 9 times in length of body; the evenly convex interorbital as wide as eye, which is 3.3 to 3.4 times in head; the eye circular and halfway between tip of snout and posterior margin of opercle; the pointed, conical snout much longer than either eye or maxillary, the latter being 3.4 to 3.5 times in length of head; the preorbital about as wide as interorbital space or diameter of eye; the mouth small, lower jaw slightly in advance of upper; there are two nostrils in front of each eye, the anterior one circular and provided with a fleshy rim which is highest behind, the other one a slightly oblique slit, somewhat hidden above by overlapping skin, and about halfway between anterior nostril and front margin of eye; the preopercle finely serrated at the angle.

The scales on sides large and in slightly oblique series, those covering head and fins becoming very small; the dorsal spines become higher posteriorly from the fourth, which is 1.9 times in length of head; the third anal spine much higher than the last dorsal spine, 1.6 times in head; both the rayed dorsal and anal broadly rounded; the caudal fin truncate; the pectoral fin pointed and longest above, 4.1 to 4.2 times in length of body or 1.3 to 1.4 times in that of head, its tip scarcely reaching above anus; the ventral fin is also pointed and ends before anus, its spine twice in head.

The ground color in alcohol yellowish brown; on each side of body below lateral line brown lines run obliquely backward and upward, following the oblique series of the scales; on each scale on anterior portion of body on the lateral line and above it is a whitish spot (carmine red or golden in life); an ocular band, narrower than eye, extends from origin of dorsal fin to lower margin of interopercle; it is blackish brown above eye and margined with pearl white and whitish below it; a broad crescentlike blackish band along base of dorsal, crossing anterior portion of caudal peduncle to middle of anal; the soft dorsal and anal show traces of the blackish inframarginal stripe; the caudal grayish along its posterior edge; the ventral whitish.

Five specimens, collected at Puerto Galera and Bulalacao Bay, Mindoro, measure 120 to 128 millimeters in length. The only previous Philippine record of this species is from Bacon, Sorsogon, by Evermann and Seale. Elsewhere it is known only from Celebes and the Moluccas.

CHÆTODON CARENS Seale. Plate 15, fig. 2.

Chætodon carens SEALE, Philip. Journ. Sci. § D **5** (1910) 116, pl. 1, fig. 1; AHL, Chaetodontidae, 77, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5 (after Seale).

Dorsal XIII, 20; anal III, 16; there are 34 scales in a lateral series, 10 between the lateral line and the origin of dorsal, and 22 between the lateral line and the origin of anal.

The body moderately deep and strongly compressed, the back much elevated and the anterior dorsal profile from tip of snout to nuchal region nearly straight, and on shoulder very slightly convex; the depth of body contained 1.7 times in length; the head as long as deep, 3.1 times in length of body; the depth of the small caudal peduncle 9.8 times in length of body or 3.1 times in that of head; the convex interorbital as wide as the length of the short pointed snout, which is contained 3.1

times in head; the large circular eye 2.8 times in head and longer than maxillary which is contained 3.8 times; the preorbital more than half as wide as eye; the small mouth slightly oblique, the jaws nearly even; the two nostrils small, close together, in front of each eye, the anterior one circular and surrounded by a fleshy rim which is highest behind, the other rounded and having a low fleshy rim in front; the preopercle finely serrated behind and below.

The scales on middle of side large, becoming smaller on the outer portions, those on head very small to minute; the lateral line is moderately arched, highest below base of posterior dorsal spines, and ends posteriorly just before axil; the dorsal spines evenly graduated from third, which is the highest and shorter than head by about two-thirds eye; the second and third anal spines of about the same height, each 1.3 times in head; the soft dorsal and anal rounded; the caudal truncate; the short pectoral is equal to head, less than half the eye, and does not extend to vertical through anus; the ventral reaches to a little behind anus, its spine 1.5 times in head.

The ground color in alcohol brownish, becoming darker on top of head, on extreme hind portion of trunk including caudal peduncle, and on vertical fins; the soft dorsal and anal narrowly edged with white; the caudal yellowish on its anterior half and dusky on the remaining portion; the ventral dusky and the pectoral yellowish.

Here described from the type and only specimen, 88 millimeters in length, Bureau of Science collection, obtained at Bantayan Island in May, 1909, by Dr. Lawrence E. Griffin.

CHÆTODON EPHIPPIUM Cuvier and Valencienes.

Chætodon ephippium CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 7 (1831) 61, pl. 174; LESSON, Zool. Voy. Coquille 2 (1830) 174; Atlas, Poiss. (1826) pl. 29, fig. 1; GÜNTHER, Cat. Fishes 2 (1860) 7; Fische der Südsee 1 (1873) 36, pl. 27, figs. A and B; SEALE, Occ. Papers Bishop Museum 1 (1901) 97; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 343; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 269; AHL, Chaetodontidae, 65, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Chætodon principalis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 62.

Chætodon mulsanti THIOLLIERE, Ichthy. l'île Woodlark (1856) 163.

Chætodon pepek MONTROUZIER, Ichthy. l'île Woodlark (1856) 163.

Tetragonoptrus ephippium BLEEKER, Atlas Ichthy. 9 (1878) 36, pl. 378, fig. 2.

Dorsal XIII, 24; anal III, 21 or 22; there are 34 to 36 scales in a lateral series, 11 between the lateral line and the origin of dorsal, and 16 between the lateral line and the origin of anal.

The body deep and much compressed, with the back a little more arched than the ventral outline, the depth contained 1.7 times in length; the head as long as deep, 3.2 to 3.4 times in length of body, the upper profile convex; the caudal peduncle deeper than long, 9.2 to 9.5 times in length of body; the broad strongly convex interorbital from 3.5 to 3.8 times in head and wider than the diameter of the small, circular eye, which is contained 4 to 4.2 times in head and situated midway between tip of snout and posterior margin of opercle; the long horizontal snout conspicuously pointed and conical, 2.4 times in length of head and 1.7 to 1.8 times eye; the short maxillary 3.8 to 3.9 times in head, a little shorter than width of preorbital which is contained 3.3 to 3.4 times; the mouth small, lower jaw slightly in advance of upper; two nostrils close together in front of each eye, the front one circular and provided with a fleshy rim which is highest behind, the posterior one a slightly oblique slit partly covered by an overhanging skin above; the preopercle finely serrated below and behind.

The scales on each side of trunk large and in regular horizontal and vertical series, those on head and fins becoming small to minute; the lateral line is strongly arched, and ceases a little in front of axil of dorsal fin; dorsal spines evenly graduated to the last, which is the highest, 1.4 to 1.5 times in head; the third anal spine 1.5 to 1.6 times in head or thrice in depth of body; the soft dorsal has the fifth ray elongate and filiform, and the rayed anal broadly rounded; the caudal truncate; the pectoral slightly rounded and longest superiorly, 2.4 to 2.5 times in depth of body, its posterior end above anus; the ventral is pointed and scarcely reaches to anus, the spine 1.8 to 1.9 times in length of head.

In alcohol the ground color varies from yellowish brown to rust brown, fading respectively into yellowish and yellowish brown below; on the lower half of body are a number of longitudinal grayish bands, which follow the horizontal series of scales; there is a trace of a vertical blackish band crossing head through each eye, and of another below fourth dorsal spine; a very large subovate black patch, edged with pearl white anteriorly and below and with yellowish above and behind, covers the greater portion of dorsal and posterior part of back; a blackish margin on spinous and soft dorsal, the latter portion having a submarginal line of black; the anal is edged with grayish and has a submarginal band of brown; the caudal rays, with the exception of the uppermost and lowermost ones, each margined above and below with blackish; the ventral and pectoral fins have the same color as the background.

Here described from three examples, 90 to 157 millimeters long, from Santo Domingo de Basco, Batan Island, Batanes Province; from the southern coast of Batangas Province; and from Tubigan Island, Sulu Archipelago. Jordan and Richardson have recorded this species previously from Cagayancillo, one of the Cagayan Islands.

This very handsome fish occurs throughout the East Indian Archipelago and Polynesia to Hawaii and the Society Islands.

CHÆTODON KLEINI Bloch. Plate 13, fig. 2.

Chætodon kleini BLOCH, Ichtyologie 7 (1797) 4, pl. 218, fig. 2; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 23; GÜNTHER, Cat. Fishes 2 (1860) 22; PETERS, Monatsber. Akad. Wiss. Berlin (1876) 832; DAY, Fishes of India (1878) 106; JORDAN and SEALE, Bull. Bur. Fisheries 26 (1907) 34; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 269; AHL, Chaetodontidae, 144, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus kleini BLEEKER, Atlas Ichth. 9 (1878) 45, pl. 373, fig. 3.

Chætodon melanomystax BLOCH and SCHNEIDER, Syst. Ichth. (1801) 224.

Chætodon melanostomus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 224.

Chætodon flavescens BENNETT, Proc. Zool. Soc. London (1831) 61.

Chætodon virescens CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 23.

Dorsal XIII (rarely XIV), 21 or 22; anal III, 18 or 19; there are 30 to 33 scales in a lateral series, 8 or 9 between the lateral line and the origin of dorsal, and 13 between the lateral line and the origin of anal.

The depth of the strongly compressed, subcircular body contained from 1.5 to 1.6 times in length, with the back highly elevated; the head very deep, its length 3.4 to 3.6 times in that of body, the dorsal profile very steep; the depth of caudal peduncle 9.5 to 9.9 times in length of body; the strongly convex interorbital contained from 2.8 to 3.4 times in head; the circular eye a little closer to tip of snout than to vertical through posterior edge of opercle, its diameter 2.8 to 3.3 times in length of head and nearly as long as the obtuse, bluntly pointed snout, which is contained from 2.6 to 3.1 times; the maxillary rather short, 3.5 to 4.4 times in head and slightly longer than width of preorbital behind it, which is greater than half eye diameter; the mouth small and nearly horizontal, the jaws equal; the nostrils small and close together in front of each eye, the anterior one with a small fleshy rim prolonged into a high flap behind, the posterior nostril oval and provided with a fleshy flap in front; the preopercular edges finely serrated.

The scales on each side of trunk moderately large, those on head, vertical fins, and caudal becoming very small; the strongly arched lateral line extends to a little in front of axil of dorsal fin; the middle dorsal spines about as high as posterior ones, the second anal spine nearly as long as third which is contained from 1.2 to 1.3 in head; both soft dorsal and anal broadly round; the caudal fin truncate; the pectoral is about as long as head and does not extend to above anus; the ventrals end at anus, their spines 1.3 to 1.5 times in head.

In life the ground color yellowish; on anterior portion of trunk a rather wide dusky brown transverse band; the posterior half shaded with brownish, which extends to caudal peduncle, anal, and soft dorsal fins; on the shaded area scattered pearl white spots; a black ocular band, nearly as wide as eye, descends from nape to extremity of ventrals; the lips and top of snout black; the soft dorsal and anal are edged with white and have a submarginal line of black; the bright lemon yellow caudal has a rather wide grayish band at posterior edge; the pectoral fin blackish.

In alcohol the ground color of body and fins yellowish brown; the ocular band and the narrow submarginal lines on soft vertical fins blackish; the dark portions on trunk deep brown, the spot on posterior half of trunk whitish to reddish; the pectoral grayish, as is the caudal at its outer margin; both the rayed dorsal and anal narrowly edged with whitish.

Here described from thirty-seven specimens, 35 to 109 millimeters long, coming from the following localities: Luna, La Union; Olongapo, Zambales; Sisiman and Mariveles, Bataan; Hamilo, Batangas; Calapan and Bulalacao Bay, Mindoro; Gigantangan Island, Leyte; Quiminatin Island, Cuyo Islands; Samal Island and Zamboanga, Mindanao; and Sibutu Island, Sulu Archipelago. The specimen from Hamilo, 90 millimeters long, is a ripe female, collected April 25, 1922.

This beautiful fish has been listed previously from the Philippines by Jordan and Seale from Manila, and by Jordan and Richardson from Cagayancillo. It occurs from the east coast of Africa, through the seas of India and the East Indian Archipelago, northward to the coast of China, and eastward to the Carolines.

CHÆTODON PUNCTATO-FASCIATUS Cuvier and Valenciennes. Plate 12, fig. 1.

Chætodon punctato-fasciatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 22; GÜNTHER, Cat. Fishes 2 (1860) 27; JORDAN and EVERMANN, Bull. U. S. Fish. Comm. 23 [1] (1903) (1905) 369, fig. 162; JORDAN and SEALE, Bull. Bur. Fisheries 26 (1906) 34; AHL, Chaetodontidae, 100, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus punctato-fasciatus BLEEKER, Atlas Ichthy. 9 (1878) 40, pl. 274, fig. 3.

Chætodon multicinctus GARRETT, Proc. Cal. Acad. Sci. 3 (1863) 65; GÜNTHER, Fische der Südsee 1 (1873) 44, pl. 34, fig. B (after Garrett's drawing).

Dorsal XIII, 23 or 24; anal III, 17 or 18; there are 32 to 38 scales in a lateral series, 9 between the lateral line and the origin of dorsal, and 16 between the lateral line and the origin of anal.

The body oblong, deep and compressed, with the back much elevated; the depth contained 1.7 times in length; the head deep, compressed, and bluntly pointed, a little shorter than deep, its length 3.2 times in that of body and its dorsal profile somewhat undulating from tip of snout to origin of dorsal; the depth of the small caudal peduncle 10 times in length of body or 3.1 to 3.2 times in depth; the convex, narrow interorbital 3.4 to 3.5 times in length of head; the eye small, circular, placed a little anteriorly, its diameter equal to the length of the blunt, slightly produced snout, which is 2.9 to 3 times in head; the maxillary rather short, 4.2 to 4.9 times in head; the width of preorbital behind maxillary a trifle greater than length of maxillary or two-thirds eye, and 3.8 to 4 times in length of head; the mouth small, jaws small and bluntly produced; the two nostrils in front of eye close together, the anterior one circular and provided with an elevated fleshy flap behind, the more posterior simple, oval, and very slightly oblique; the preopercle entire.

Moderately large scales cover side of body, those on head and vertical fins becoming very small; the lateral line moderately arched, ending below base of posterior dorsal rays; the middle dorsal spines higher than the last one, which is contained 1.4

times in length of head; the second and third anal spines of about the same height, each being higher than last dorsal spine; both dorsal and anal fins rounded posteriorly; the caudal fin convex; the pointed pectoral is about as long as head and does not quite extend to anus; the ventral fin ends at anal opening, its spine 1.4 times in head.

The ground color of nearly fresh specimens was bright lemon yellow; each scale on body had an olive spot at base, the spots becoming smaller on the scales toward fins; the side of body had seven nearly vertical olive bands, the first and last ones indistinct; there was a black spot on nape of neck; just below this spot a yellowish band edged with olive ran down through eye to inferior limb of preopercle; the dorsal fin had an outer margin of lemon yellow, and two submarginal lines of black and white; the caudal fin was lemon yellow near base and brownish outwardly, the two colors being separated by a black crossband; the anal fin had two submarginal lines of black and white, the margin of the fin was lemon yellow; both pectoral and ventral were lemon yellow.

In alcohol the ground color turned yellowish brown, the spots on the scales dusky; the vertical bands on side brownish olive; the ocular band is reduced to a pale, brown-edged streak; the spot above occiput before origin of dorsal and the crossband on caudal black; the submarginal lines on the vertical fins of blackish and whitish coloration.

The above account is based upon a study of two Bureau of Science specimens, 68 and 70 millimeters in length, from the southern coast of Batangas Province, and Calapan, Mindoro. A previous Philippine record of this species is that of Jordan and Seale, of three examples, purchased in the Manila market.

Elsewhere this species is known from the seas of Banda and the Hawaiian Islands, and undoubtedly occurs in the intervening regions.

CHÆTODON UNIMACULATUS Bloch. Plate 11, fig. 1.

Chætodon unimaculatus BLOCH, Ichtyologie 6 (1788) 54, pl. 201, fig. 1; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 55; GÜNTHER, Cat. Fishes 2 (1860) 11; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) pl. L and fig. 161; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 342.

Tetragonoptrus unimaculatus BLEEKER, Atlas Ichth. 9 (1878) 45, pl. 375, fig. 5.

Chætodon sphenospilus JENKINS, Bull. U. S. Fish. Comm. 19 (1899) (1901) 395, fig. 8.

Dorsal XIII, 22 or 23; anal III, 19 or 20; there are 40 scales in a lateral series, 10 between the lateral line and the origin of dorsal, and 19 between the lateral line and origin of anal.

The body deep, compressed, with the dorsal profile a little deeper than the ventral; the depth of body contained 1.5 to 1.6 times in length; the head slightly shorter than deep, its length 3.1 to 3.4 times in that of body, and its upper profile obliquely concave; the depth of the short caudal peduncle 8.9 to 9.2 times in length of body or 5.8 to 6 times in depth; the interorbital space broad and slightly convex, its width 2.8 to 3.1 times in length of head; the eye small, circular and placed about midway from tip of snout to vertical passing through posterior edge of opercle, its diameter 3 to 3.7 times in head; the snout bluntly rounded and rather short, 2.4 to 2.8 times in head; the maxillary is much shorter than snout, contained 3 to 3.4 times in head, and does not quite reach to below front edge of orbit; the width of preorbital about two-thirds diameter of eye; the mouth small, gape short, and jaws equal and slightly produced; the two nostrils in front of eye close together, the anterior one with a fleshy flap which is highest posteriorly, the other oval and oblique; the marginal portion of preopercle not serrated.

The scales on side of body large anteriorly, becoming smaller posteriorly and toward fins, arranged in nearly horizontal series; the moderately arched lateral line ends below base of last dorsal rays; the middle dorsal spines slightly higher than the posterior ones, the rayed vertical fins rounded posteriorly; caudal slightly convex; the pointed pectoral nearly as long as head; the ventral fin also pointed, its spine a little shorter than last dorsal spine, and 1.5 to 1.6 times in length of head.

The color in life of a young specimen obtained at Sitankai Island, Sulu Archipelago, was yellow, with a black ocular band which descended from top of head and nape to breast and was about as broad as eye; a narrower black band over the posterior portions of the rayed vertical fins and across caudal peduncle; the remaining portion of dorsal and anal, and the other fins were colored similarly to body; there was a large round black spot on lateral line below the six posterior dorsal spines.

In alcohol the ground color is paler, and the bands across head and over the soft vertical fins and caudal peduncle are brownish black; the large blotch on lateral line also brownish black.

Of this species we have examined ten examples, varying from 19.5 to 135 millimeters in length. They were collected at Santo Domingo de Basco, Batan Island, Batanes Province;

Mariveles, Bataan Province; southern coast of Batangas Province; Tagapula Island, Samar; New Washington, Capiz; Simara Island, Romblon Province; Quiminatin Island, Cuyo Islands; Jolo and Sitankai in the Sulu Archipelago. It has been recorded previously in the Philippines by Evermann and Seale from Bacon, Sorsogon.

This handsome, widely distributed species occurs from Ceylon through the East Indies to Hawaii and Tahiti.

On some specimens, particularly in the young, there is a more or less well-developed wedge-shaped area extending downward from the large black blotch on the lateral line. This is rarely the case in Philippine specimens. The two specimens from Mariveles, Bataan Province, collected April 24, 1922, each with a length of 95 millimeters, were ripe females ready to spawn.

CHÆTODON TRIFASCIATUS Mungo Park. Plate 13, fig. 1.

Chætodon trifasciatus MUNGO PARK, Trans. Linn. Soc. **3** (1797) 34; JENKINS, Bull. U. S. Fish Comm. **22** (1902) (1903) 474; JORDAN and EVERMANN, Bull. U. S. Fish Comm. **23**[1] (1903) (1905) 372, pl. 52; JORDAN and SEALE, Bull. Bur. Fisheries **25** (1905) (1906) 344; Bull. Bur. Fisheries **26** (1906) (1907) 33; JORDAN and RICHARDSON, Bull. Bur. Fisheries **23** (1907) (1908) 269; WEBER, Fische Siboga Exp. (1913) 304; AHL, Chaetodontidae, 56, in Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Chætodon trifasciatus var. *arabica* STEINDACHNER, Denkschr. Akad. Wiss. Wien **71** (1902) 138, pl. 2, fig. 3.

Tetragonoptrus trifasciatus BLEEKER, Atlas Ichthy. **9** (1878) 35, pl. 377, fig. 1.

Chætodon vittatus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 227; CUVIER and VALENCIENNES, Hist. Nat. Poiss. **7** (1831) 26; LAY and BENNETT, Fishes in Zool. Beechey's Voy. (1839) 61, pl. 17, fig. 3; GÜNTHER, Cat. Fishes **2** (1860) 23; DAY, Fishes of India (1878) 107, pl. 27, fig. 5.

Chætodon tau-nigrum CUVIER and VALENCIENNES, Hist. Nat. Poiss. **7** (1831) 29; GÜNTHER, Cat. Fishes **2** (1860) 32.

Chætodon austriacus RÜPPELL, Neue Wirbelt. Abyssinien, Fische (1835) 30, pl. 9, fig. 2.

Dorsal XIII, 21 to 23; anal III, 18 to 20; there are 32 to 38 scales in a lateral series, 6 or 7 between the lateral line and the origin of dorsal, and 14 or 15 between the lateral line and the origin of anal.

The depth of the compressed and rather elongate body 1.6 to 1.8 times in length; the back trenchant, head deep, its profile steep above and its length 3.1 to 3.5 times in length of body; the depth of the small caudal peduncle 9.5 to 9.9 times in length of body; the broad, strongly convex interorbital 2.6 to 3.2 times in head; the circular eye 2.8 to 3.2 times, rather high and anterior in head; the snout short, bluntly rounded, 2.8 to 3.6 times in length of head; the maxillary very short and contained from 3.5 to 4.1 times in head, a little longer than width of interorbital behind it, which is about half the diameter of eye; the small mouth horizontal, jaws even; the two nostrils before eye close together, the first one circular and having a fleshy rim around it which is highest behind, the posterior one a simple rounded opening; the preopercle serrated behind and below.

The scales on side of body large and in nearly vertical series, becoming small toward head, and on vertical fins and caudal; the lateral line is slightly arched and ends below anterior third portion of the rayed dorsal; the sixth and seventh dorsal spines highest, each 1.3 to 1.4 times in depth of body and slightly longer than third anal spine, which is contained from 1.2 to 1.5 times in head; the soft portions of vertical fins rather angular posteriorly; the caudal fin small and convex behind; the pectoral fin about as long as head and contained from 2 to 2.3 times in depth of body, its tip above anus; the ventral fin scarcely reaches anus, its spine 1.5 to 1.8 times in head.

The ground color in life creamy orange, grayer above, with many longitudinal streaks of violet-blue along sides; the forehead brown, jaws and chin blackish; a golden yellow band crosses head through anterior portion of eye; a black ocular band, narrower than orbit, descends from nape to the most anterior part of breast; behind this band a golden yellow one, crossing hind portion of eye, which is bordered behind by another narrow vertical black streak passing through posterior limb of preopercle; the opercle creamy orange; the spinous dorsal yellowish, with purplish lines below; the soft dorsal has a black band near base, which becomes wider posteriorly and extends to top of caudal peduncle; this band bordered on each side with golden yellow; the rest of the color markings of dorsal as follows outwardly: A violet line running longitudinally across middle, then a broad yellowish band, a violet-gray line, and a rather wide creamy brown marginal band; the caudal peduncle slaty, the middle of caudal fin crossed by a black, gold-margined band; the anal rays have a basal black gold-margined bar, their margin yellow or clear; the spinous portion of anal rich brown; the ventral fin golden yellow and the pectoral transparent.

In alcohol the ground color yellowish, the darker portions of head blackish and the lighter ones whitish; the longitudinal stripes on body violet-brown; the black bands and lines on caudal and vertical fins still distinct, and the lighter portions yellowish; the spinous portion of anal brownish and the dark brown band on fin has turned blackish; the pectoral is pale and the ventral has a yellowish wash.

The Bureau of Science specimens are from 50 to 101 millimeters long, and were collected at the following places:

Mariveles, Bataan, 1.
Aloneros, Tayabas, 3.
Calapan, Mindoro, 19 specimens, two of which are ripe females, 90 and 101 millimeters long, collected January, 1921.
Bulalacao Bay, Mindoro, 1.
Tablas Island, 1.
Bantayan Island, 1.
Quiminatin Island, Cuyo Islands, 2.
Puerto Princesa and Balabac Island, Palawan, 5.
Cagayan, Misamis Province, Mindanao, 1.
Basbas, Tawitawi, Bungau, Sibutu, and Sitankai Islands, Sulu Archipelago, 11.

This species has been recorded previously from the Philippines by Jordan and Seale from Cavite and by Jordan and Richardson from Cagayancillo. It is very common in the East Indies and ranges from the east coast of Africa to Polynesia, where it occurs as far southeastward as the Paumotu Islands, and north to Hawaii.

CHÆTODON BENNETTI Cuvier and Valenciennes. Plate 8, fig. 2.

Chætodon bennetti CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 64; GÜNTHER, Cat. Fishes 2 (1860) 12; PLAYFAIR, Fishes of Zanzibar (1866) 33; GÜNTHER, Fische der Südsee 1 (1873) 37, pl. 29, fig. A; AHL, Chaetodontidae, 73, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Chætodon vinctus BENNETT, Zool. Beechey's Voyage Fishes (1839) 62, pl. 17, fig. 1 (very bad).

Tetragonoptrus bennetti BLEEKER, Atlas Ichth. 9 (1878) 34, pl. 376, fig. 2.

Dorsal XIV, 17; anal III, 16; there are 46 scales in a lateral series, 12 between the lateral line and the origin of dorsal, and 18 between the lateral line and vent. Elsewhere specimens vary as follows: Dorsal XIII–XIV, 17 to 19; anal III, 15 to 17; lateral series of scales 40 to 46; transverse 9 or 10 and 17 to 20.

The body deep, rather thick, with the dorsal and ventral profiles about equally elevated, the depth 1.5 times in length; the small head slightly shorter than deep, 3.5 times in length of body, dorsal profile oblique and nearly straight; the caudal peduncle deeper than long, its least depth 8.8 times in length of body or 2.5 times in length of head; the strongly convex interorbital rather wide, 2.8 times in head; the eye circular, a little anterior, its diameter 3.3 times in head; the snout obtuse, nearly equal to width of interorbital or 2.7 times in head; the maxillary nearly as long as eye, 3.5 times in head; the preorbital wider than half eye diameter; the mouth small and slightly oblique, jaws about even; two nostrils in front of each eye, both circular, the anterior one has a wide fleshy flap behind and the other is a simple opening; the preopercle finely serrated behind and indistinctly denticulated at the angle.

The scales covering side moderate in size, those on head and fins from small to minute; the lateral line is very slightly arched and stops a little before the axil of the rayed dorsal fin; of the dorsal spines the middle ones are the highest; the second and third anal spines about equal in height, each 1.4 times in head; the soft portions of vertical fins rounded; the caudal fin rather truncate; the pectoral fin pointed and longest superiorly, ending some distance before vertical through anus; the ventral is also pointed and does not reach anus, its spine 1.5 times in length of head.

The ground color in alcohol deep yellowish brown; a white-edged blackish violet band descending from back of neck through eye to lower edge of interopercle and a large, round, white-edged black blotch on lateral line on each side of back below posterior dorsal spines; two oblique pearl white bands run from opercle toward anal fin, one above the root of pectoral and the other below; the soft vertical fins and the caudal broadly margined with blackish; the other fins yellowish.

Here described from a specimen in the Bureau of Science collection, 132.5 millimeters in length, obtained on the southern coast of Batangas Province. It is a ripe female, collected March 15, 1925.

This unusually beautiful species, which is new to the Philippines, is recorded from Zanzibar, the Moluccas, and several Polynesian groups of islands.

CHÆTODON SPECULUM Kuhl and Van Hasselt. Plate 14, fig. 2.

Chætodon speculum Kuhl and Van Hasselt in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 56; GÜNTHER, Cat. Fishes 2 (1860) 12; WEBER, Fische Siboga Exp. (1913) 304; AHL, Chaetodontidae, 75, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Citharoedus speculum KAUP, Archiv für Naturg. 26 (1860) 145.

Tetragonoptrus speculum BLEEKER, Ned. Tijd. Dierk. 2 (1865) 189; BLEEKER, Atlas Ichthy. 9 (1878) 34, pl. 375, fig. 3.

Dorsal XIV, 17; anal III, 16; there are 38 to 40 scales in a lateral series, 12 between the lateral line and the origin of dorsal, and 18 between the lateral line and the origin of anal.

The body compressed and deep, 1.5 to 1.6 times in length, the profiles about equally elevated; the small head much shorter than deep, 3.2 to 3.5 times in length of body, its upper profile almost straight and very steep; the depth of the short caudal peduncle 4.7 to 6 times in that of body or 7.7 to 8.7 in its length; the wide, convex interorbital 2.7 to 2.9 times in length of head and wider than either length of maxillary or diameter of eye, which are contained 3.3 to 3.5 and 2.9 to 3.3 times, respectively; the snout short and obtuse, 2.7 to 2.9 times in head; the eye circular and slightly anterior; the preorbital slightly concave in front, its greatest width almost two-thirds diameter of eye; the mouth small, its gape slightly oblique and the jaws equal; the two nostrils in front of each eye close together, the anterior one circular and having a fleshy rim which is deepest behind, the other a simple oval opening, nearly vertical in position; the preopercle serrated behind and below.

The scales on side moderate in size, those on head and fins small to minute; the slightly arched lateral line ends below posterior third portion of rayed dorsal; middle dorsal spines highest, the last one shorter than third anal spine, which is 1.3 to 1.4 times in length of head and about as long as second anal spine; the soft portions of dorsal and anal broadly rounded; the caudal slightly convex; the pectoral pointed and longest above, 2.3 to 2.8 times in depth of body, ending some distance before vertical through anus; the ventral fin does not extend to anus, its spine 1.3 to 1.5 times in head.

The ground color in alcohol yellowish brown; a blackish ocular band, which is slightly convex anteriorly and narrower than eye, descends from nape to breast, joining with the opposite band above and below; a large blackish ovate blotch about the size of head on side below middle of dorsal fin; a rather wide grayish band on outer portion of caudal fin, the rest of the fin yellowish; the other fins yellowish.

Here described from seven fairly large specimens measuring from 92.5 to 122 millimeters in length. They were collected in the following localities: Southern coast of Batangas Province; Calapan, Mindoro; Masbate Island; Gigantangan Island, Leyte; and Quiminatin Island, Cuyo Islands. With the exception of the specimens from Calapan and Quiminatin, all are females nearly ready to spawn and were collected February 19 and March 15, 1925, and June 5, 1922.

This species, which is new to the Philippines, occurs elsewhere only from the Moluccas to New Guinea.

In general coloration and proportions, this species closely resembles *Chætodon bennetti* (Bleeker), from which it differs in the absence of two white lines running obliquely backward from the opercle, and of the blackish edges on the caudal and soft vertical fins.

CHÆTODON CITRINELLUS Broussonet. Plate 14, fig. 1.

Chætodon citrinellus Broussonet in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 21; CUVIER, Règne Anim., Poiss. (1817) pl. 39, fig. 1; GÜNTHER, Cat. Fishes 2 (1860) 33; Fische der Südsee 1 (1873) 47, pl. 35, fig. B (figure poor); JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1903) 357; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 344; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 269; AHL, Chaetodontidae, 104, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Tetragonoptrus miliaris (not of Quoy and Gaimard) BLEEKER, Atlas Ichth. 9 (1878) 39, pl. 377, fig. 3.

Chætodon nigripes DE VIS, Proc. Linn. Soc. N. S. Wales 9 1(884) 453.

Dorsal XIV, 22; anal III, 17; there are 40 to 42 scales in a lateral series, 10 between the lateral line and the origin of dorsal, and 16 between the lateral line and the origin of anal.

The deep body strongly compressed, with the back very much elevated, the depth 1.7 to 1.9 times in length, the head a little shorter than deep, 2.9 to 3.2 times in length of body, the upper profile along interorbital space slightly arched; the depth of caudal peduncle 8 to 9.2 times in length of head; the broad, evenly convex interorbital 3.3 to 3.5 times in head; the circular eye fairly large, its diameter 2.5 to 2.7 times in head; the short and slightly pointed snout slightly shorter than eye, 2.7 to 3.3 times in head; the maxillary as long as width of preorbital, which is 3.8 to 4 times in length of head and narrower than diameter of eye; the mouth small and horizontal, jaws about even; the two nostrils close together in front of each eye simple circular openings, the anterior one the smaller; the preopercle distinctly serrated.

The scales on side moderate in size, those on head, vertical fins, and caudal very small; the moderately arched lateral line stops in front of axil of dorsal fin; the middle dorsal spines higher than the posterior ones, the third anal spine shorter than second which is 3.6 times in head; the soft dorsal and anal rounded; the caudal fin slightly convex; the pectoral equals head in length and ends above anus; the ventral extends to base of first anal spine, its spine 3.9 to 4.1 times in length of head.

The ground color in alcohol yellowish, with a blue spot on each scale of body; some scales on soft dorsal have each a bluish spot; a black ocular band, edged in front and behind with white, descends from origin of dorsal to lower edge of interopercle; the spinous dorsal and anterior portion of soft dorsal are narrowly edged with white and have a very fine submarginal line of blackish; the anal is yellowish and has a rather wide blackish margin on its anterior two-thirds; both caudal and pectoral yellowish; the ventrals a little dusky.

The above account is of four specimens, 29 to 47 millimeters long, collected at Luna and Paraoir, both of La Union Province. This species, previously recorded from Cagayancillo by Jordan and Richardson, occurs throughout the East Indies and southeastward in Polynesia to Tahiti.

McGregor's color notes on the Cagayancillo specimen are as follows:

> Color in life, white with greenish wash, each scale with a violet spot; the body white below line of pectoral; scale spots pale yellow on caudal peduncle, base of caudal, and posterior margins of dorsal and anal; a black spot on snout; a dark band from predorsal region through eye to lower margin of gill cover; the band above the eye bordered on each side with pale green; membranes of spinous dorsal light blue at base, light yellow above; anal with terminal black band and subterminal light yellow band, these divided by a narrow pale blue line; caudal light golden yellow; ventral pale pea green, except the two shortest rays; pectorals clear.

Genus CORADION Kaup

Coradion KAUP, Wiegmann's Archiv Naturg. 26[1] (1860) 137 and 146.

The subrhomboid body rounded to angular, with a nearly vertical base for the greater part of the soft dorsal and anal fins; dorsal spines 8 to 10, dorsal rays weak, 25 to 30; anal spines 3, both fins with obtuse rays; the characteristic mouth small, with thick, swollen, plaited lips, the short teeth hardly visible; the preoperculum toothed; the gill rakers weak and in part branched like trees; the lateral line has distinct pores and continues to base of caudal; 45 to 50 scales in a longitudinal series; the posterior margin of caudal convex or straight; the ventral elongate, reaching to second anal spine.

Two species, occurring in the East Indies and eastward to the Bismarck Archipelago. But one is thus far known from the Philippines.

CORADION CHRYSOZONUS (Kuhl and Van Hasselt).

Chætodon chrysozonus Kuhl and Van Hasselt in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 62; CUVIER, Règne Anim., Poiss. (1817) pl. 38, fig. 2; GÜNTHER, Cat. Fishes 2 (1860) 34; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 (1922) 55.

Coradion chrysozonus KAUP, Archiv Naturg. 26 (1860) 146; BLEEKER, Atlas Ichthy. 9 (1878) 25, pl. 376, fig. 5; WEBER, Fische Siboga Exp. (1913) 309; AHL, Chaetodontidae, 40, in Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Chætodon lubiatus Kuhl and Van Hasselt in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 63.

Dorsal IX, 27 to 29; anal III, 20 or 21; there are 37 to 39 scales in a lateral series, 11 or 12 scales between the lateral line and the origin of dorsal, and 21 between the lateral line and the origin of anal.

The depth of the strongly compressed subcircular body 1.3 to 1.5 times in length, the dorsal outline more elevated than the ventral; the head slightly shorter than deep, contained from 2.6 to 2.8 times in length of body, its dorsal profile slightly concave; the caudal peduncle rather deep, 7.7 to 8.5 times in length of body; a bony protuberance near orbit on each side of interorbital space, which is convex and 3.7 to 4.1 times in length of head; the circular eye superior and anterior in head, fairly large, its diameter 3.3 to 4.2 times in length of head; the snout blunt and rather long, 2.6 to 3 times in head; the maxillary contained from 3.8 to 5.2 times in head, and longer than width of preorbital which is greater than two-thirds eye diameter; the mouth very small and horizontal, the jaws equal, the lips thick and arched in front, giving a rounded appearance to mouth when viewed from front; the two nostrils close together in front of each eye, the anterior one a little larger, circular, with a fleshy rim, the posterior part very high, the posterior nostril oval and near edge of orbit; the preopercle distinctly serrated below and behind.

The scales on each side of body moderate in size and in nearly vertical series, those on head, vertical fins, and caudal very small; the lateral line strongly arched, and angular below base of anterior dorsal rays, its posterior end on caudal peduncle; the dorsal spines evenly graduated to the last, which is the highest and contained from 1.2 to 1.5 times in head; the third anal about as long as ventral spine, which is 1.3 to 1.7 times in head;

both the rayed dorsal and anal broadly rounded; the caudal fin very slightly convex; the pectoral fin, which is about as long as last dorsal spine, ends above anus; the ventral is very long and extends to base of anterior anal rays.

In life the ground color is yellowish white, crossed by a wide brownish vertical band on anterior portion of trunk and by another on hind portion; the first band is split above and the second one extends upon the vertical fins; on each side of body, following the longitudinal rows of scales, are narrow, bright lemon yellow stripes, those above lateral line arched upward, those below lateral line nearly horizontal; a deep brown ocular band descends from nape to breast; a deep brown longitudinal band runs along middle of head to tip of snout; the chin deep brown; a deep brown, white-edged ocellus near base of middle dorsal rays; a wide black band, edged in front and behind with white, on base of caudal fin and posterior portion of peduncle, the rest of the fin yellowish; the vertical fins are edged with yellowish white and have a narrow submarginal band of black; the pectoral yellowish white and the ventral blackish.

The ground color in alcohol yellowish brown, the dark portions on head, trunk, and fins blackish brown; the longitudinal light bands whitish; the color of ventrals blackish violet.

The above description is taken from eleven specimens, 47 to 133 millimeters long, from the following localities:

Calapan, Mindoro, 1.
Bulalacao Bay, Mindoro, 1.
Masbate Island, 2 specimens, one a ripe female, 83 millimeters long, collected July 1, 1922.
Tagapula Island, Samar, a ripe female, 133 millimeters long, collected February 19, 1925.
Gigantangan Island, Leyte, a ripe female, 120 millimeters long, collected February 19, 1925.
New Washington and Estancia, Panay, 3 specimens, one a ripe female, 94 millimeters long, collected in July, 1922.
Bantayan Island, 2.

Occasionally fine specimens are seen in the Manila market. The first Philippine record of this species is that by Fowler and Bean of a single specimen, 94 millimeters long, from Cebu. It is common on the coast of Java, and is rather rare in other parts of the East Indies. Its northern range extends to the coast of China.

Genus MICROCANTHUS Swainson

Microcanthus SWAINSON, Nat. Hist. Fishes 2 (1839) 215.

This genus is separated from *Chætodon* by its smaller scales, having about 55 to 60 in the lateral line. The soft dorsal and anal are shorter than is usual in *Chætodon*, the fin formula being dorsal X or XI, 17 or 18; anal III, 14 to 16.

A group with apparently but one species.

MICROCANTHUS STRIGATUS (Cuvier and Valenciennes). Plate 18, fig. 1.

Chætodon strigatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 19, pl. 170; SCHLEGEL, Fauna Japonica, Pisces (1842) 80, pl. 41, fig. 1; GÜNTHER, Cat. Fishes 2 (1860) 34; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 376.

Dorsal X or XI, 17 or 18; anal III, 14 to 16; there are 53 to 55 scales in a lateral series, 16 between the lateral line and the origin of dorsal, and 24 betwen the lateral line and the origin of anal.

The body rather deep, short, and compressed, with the back much elevated and anterior dorsal profile from tip of snout to origin of dorsal fin a little concave, the concavity directly above pupil of eye; the depth of body contained from 1.7 to 2 times in length; the head rather small and pointed, a little longer than deep, 2.5 to 2.9 times in length of body; the compressed caudal peduncle deeper than long, its depth 6.8 to 7.2 times in length of body; the interorbital space broad, slightly and evenly convex, 3.2 to 3.8 times in length of head; the diameter of the circular, exceedingly large eye from 2.7 to 3.1 times in head; the snout a little pointed in lateral view and bluntly rounded from top, 3.1 to 3.4 times in head or a little shorter than eye diameter, with the tip on level with lower edge of orbit; the short maxillary contained from 3.4 to 3.8 times in head; the mouth small and terminal with the gape very slightly oblique and the jaws even, small, and a little produced; the teeth sharp, pointed, pungent, and in a rather broad band in each jaw; the entire preorbital about half diameter of eye; the two nostrils close together in front of orbit and both provided with a rather low marginal flap, the anterior one rather small and circular and the posterior one a short slit; the preopercle very distinctly serrated behind, at its angle and on posterior portion of lower edge; all other opercular bones entire.

The scales rather small, weakly ctenoid, those on soft vertical and caudal fins very small; there are also small scales at base of pectoral and ventral fins; the lateral line very distinct, evenly arched to caudal peduncle, and then straight to base of caudal fin; the dorsal spines decrease in height from third or fourth, which is about two-thirds length of head; third anal spine longest, 1.6 to 1.9 times in length of head; the anterior dorsal and anal rays highest; the caudal fin concave, with the lobes slightly pointed; the pectoral is rather small, a little shorter than ventral, or 1.4 to 1.6 times in head, and ends about the width of eye before anus; the outer ray of ventral is a little produced and extends to anus.

In alcohol the ground color yellowish; there are six dark brown, rather broad horizontal bands on each side of body, the first one of which is on spinous dorsal and anterior rays; the second one runs along base of dorsal spines and across middle of soft dorsal; the third is along back and posterior dorsal rays; the fourth commences at occiput and ends at middle of caudal fin base; the fifth begins above eyes and crosses body to posterior portion of anal; the sixth runs from tip of snout to base of pectoral, thence to base of anal spines and on anterior rays; both pectoral and caudal fins light brown; the ventrals light brown at base, their outer portions blackish; there is a narrow whitish margin to both soft dorsal and anal.

Here described from four examples, 34 to 112 millimeters long, taken at Amoy, Dodd Island Lighthouse near Amoy, and Hongkong.

This species, which probably occurs in the northernmost Philippine islands is known thus far only from the seas of China and Japan, and from the Hawaiian Islands.

Genus HEMITAURICHTHYS Bleeker

Hemitaurichthys BLEEKER, Syst. Percarum revisum, Arch. Neerl. Sci. Nat. 11 (1876) 304.

Dorsal XI or XII, 24 or 25; anal III, 19 to 21; lateral line 60 to 75.

Body elliptical or oblong, with pointed head, the lateral line arched high along back, descending after the middle and continued upon caudal peduncle; angle of preoperculum somewhat extended and feebly serrate; snout slightly produced, teeth small, brushlike; caudal gently rounded or truncate.

Close to *Heniochus* but easily distinguished by the dorsal spines, none of which are lengthened; distinguished from *Chætodon* by the larger number of scales in horizontal rows; it differs from *Microcanthus* in the larger number of soft dorsal and anal rays, the weaker teeth, and the finer serration of the preopercle.

Two species, one from Mauritius, the other East Indian.

HEMITAURICHTHYS POLYLEPIS (Bleeker).

Chætodon polylepis BLEEKER, Act. Soc. Indo-Neerl. 2 (1857) Achtste Bijdrage Vischfauna Amboina, 54; GÜNTHER, Cat. Fishes 2 (1860) 25.

Tetragonoptrus polylepis BLEEKER, Ned. Tijd. Dierk. 1 (1863) 70.
Hemitaurichthys polylepis BLEEKER, Atlas Ichthy. 9 (1877) 30, pl. 16, fig. 4; AHL, Chaetodontidae, 37, in Archiv für Naturg. **89** (1925) Abt. A, Heft 5.

Dorsal XII, 24 to 26; anal III, 21; 60 to 68 scales in lateral line, 14 between lateral line and origin of dorsal, and 30 to 33 between line and origin of anal.

Body very deep and strongly compressed, with the dorsal outline more elevated than the ventral; depth contained from 1.5 to 1.6 times in length; the head, which is pointed in front, about as long as deep, 3 to 3.1 times in length of body, its dorsal profile very steep and a trifle concave before the interorbital space; depth of caudal peduncle 8.4 to 9 times in length of body; interorbital space strongly convex, its least width 3 times in head; the circular eye situated about midway between tip of snout and a vertical through posterior margin of opercle, its diameter 3.2 to 3.3 times in head; snout pointed and longer than eye, 2.6 to 2.7 times in head or 1.6 to 1.7 times maxillary; width of preorbital at angle of mouth 4.6 to 4.8 times in head; mouth small and horizontal, with the jaws about even; two nostrils in front of each eye, the anterior one rounded and having a deep fleshy flap behind, the other a small simple slit; preopercle finely serrated at its hind and inferior margins.

The scales covering trunk small, those on head and fins very small to minute; the lateral line is deeply arched and extends to base of caudal fin; the middle dorsal spines higher than the others, third anal spine 1.5 times in head; both rayed dorsal and anal broadly rounded; caudal truncate; pectoral slightly longer than head, 2.9 to 3 times in length of body; the ventral fin is as long as the pectoral and extends to base of anal spines, its spine slightly greater than half its length or 1.6 to 1.9 times in head.

Fresh specimens were pearl gray on belly, sides, and caudal, the gray forming a triangle with its apex at base of seventh to ninth dorsal spines and running down to origin of pectoral and anterior extremity of caudal peduncle; a brilliant yellow triangle on upper anterior part of body, its base from third to sixth or seventh dorsal spine, its apex extending to or nearly to origin of pectoral; a broad, convex, brilliant yellow band, including the three posterior dorsal spines, base of soft dorsal and part of upper posterior part of trunk, extends down to origin of caudal peduncle; everything before a line from second dorsal spine to the ventrals yellowish olive brown; a brilliant yellow band on basal half of anal; first two dorsal spines olive brown; rest of dorsal spines and anal spines bright yellow; pectorals, ventrals, caudal, and outer parts of soft dorsal and anal all uniform pearl gray.

Here described from nine handsome specimens, 110 to 121 millimeters in length, collected on a reef at Quiminatin Island, a southern outpost in the Sulu Sea of the Cuyo Islands.

This uniquely marked fish has hitherto been reported only from Amboina, Timor, and New Guinea.

Genus HENIOCHUS Cuvier

Heniochus CUVIER, Règne Anim. 2 (1817) 335.

This genus is especially distinguished by its greatly compressed and elevated body; bony projections or horny spines, often curved and sharp pointed, are developed above the eyes, their number and size varying greatly with age in the different species, in some very prominent in early maturity and decreasing with advancing years, in others growing larger with old age; the dorsal spines vary from 11 to 13, the fourth elongated, in some species excessively so, with threadlike tip; the concave snout short or of only moderate length, the preopercle unarmed or serrate; the scales of moderate size; an air bladder present; there is a small number of pyloric appendages; branchiostegals 5; teeth villiform, none on palate.

The singular form, remarkable streamers, strongly contrasting colors, and stately carriage of these fishes excite the admiration of every beholder. They are among the most attractive of aquarium fishes.

A small genus, occurring from Mauritius to the South Sea Islands and Hawaii, and carried north to Japan by the Kuro-Siwo. The species are few in number, all characterized by broad crossbands. The genus is close to *Chætodon,* but easily distinguished by the elongated fourth dorsal spine.

Key to the species of Heniochus.

a^1. Body with two black transverse bands on each side. **H. acuminatus.**

a^2. Body with three or more black bands on each side.

  b^1. Two black transverse bands on each side of head. **H. singularius.**

  b^2. Only one black transverse band on each side of head.

    c^1. The black band on head descending to chin and breast; the third band, rather indistinct, entirely on the rayed dorsal. **H. varius.**

c^2. The black band on head descending to belly; the third band running from the last five dorsal spines to root of caudal fin, covering base of dorsal rays.

H. permutatus.

HENIOCHUS ACUMINATUS Linnæus. Plate 19, fig. 2.

Chætodon acuminatus LINNÆUS, Syst. Nat. ed. 10 (1758) 272.

Heniochus acuminatus CUVIER and VALENCIENNES, Syst. Nat. Hist. Poiss. 7 (1837); JORDAN and EVERMANN, Fishes of Hawaii, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 376, pl. 55; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1906) 97.

Chætodon macrolepidotus LINNÆUS, Syst. Nat. ed. 10 (1758) 274; BLOCH, Ichtyologie 6 (1788) 50, pl. 200, fig. 1.

Heniochus macrolepidotus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 70; SCHLEGEL, Fauna Japonica, Poiss. 82 (1842) pl. 44, fig. 1; GÜNTHER, Fische der Südsee 1 (1873–1875) 48, pl. 37; DAY, Fishes of India (1878) 110, pl. 28, fig. 3; MEYER, Ann., Soc. España Hist. Nat. 14 (1885) 17.

Taurichthys macrolepidotus BLEEKER, Atlas Ichthy. 9 (1878) 29, pl. 367, fig. 1.

Dorsal XI or XII, 23 to 25; anal III, 17 to 19; there are 50 to 57 scales in the lateral line; 11 or 12 between the lateral line and the origin of dorsal, and 21 to 23 from the lateral line to the origin of anal.

The anterior dorsal profile almost an even curve from posterior portion of interorbital to origin of dorsal; the interorbital space strongly convex, with a bony projection on each side, which becomes prominent with age; the greatest depth of body above base of ventrals, 1.3 to 1.5 in total length; the head rather small, 2.6 (2.2) to 3 in length; the diameter of eye greater than width of interorbital and 2.8 to 3.6 in length of head; the snout longer than eye, 2.7 to 3.3 in head; the orbit has on its margin fine serrations which are more distinct in older specimens; the preopercular edges finely serrated; the opercle armed posteriorly with a flat, rather pointed spine.

The fourth dorsal spine the longest, produced into an exceedingly long filament which extends beyond tip of caudal; both second and third anal spines of nearly same length, the former much the stronger; the soft dorsal lower and much more rounded than the soft anal; the ventral fin extends beyond anus, its spine almost equal to length of head from tip of snout to hind edge of preopercle; the pectoral fin just touches a vertical passing through anal opening.

The ground color in alcohol yellowish white; two black bands cross body obliquely backward; the anterior band runs from first four dorsal spines to ventrals, belly, and tips of anterior half of anal, touching posterior margin of opercle and root of pectoral; the second band is between the sixth and the tenth dorsal spines and the posterior half of soft anal, covering behind a small part of caudal peduncle; the dorsal rays, caudal, and free portion of pectoral lemon yellow; the base of the pectoral rays, the ventrals, the interorbital space above eyes, the upper surface of preorbital, and lips black; rest of body yellowish white.

Thirty-four specimens, ranging in length from 35 to 178 millimeters, were collected from the following localities:

Subic Bay, Zambales, 2.
Puerto Galera, Mindoro, 1.
Calapan, Mindoro, 13.
Gaspar Island, Marinduque, 5.
Bennett Island, Masbate, 2.
Gato Island, and Cebu, Cebu Province, 2 each.
Buenavista, Guimaras, 2.
Jolo, Sulu Province, 5.

This species has been recorded from Manila by Cuvier and Valenciennes and by Bleeker; from Cebu, Cebu Province, by Meyer, and from Bacon, Sorsogon, and from San Fabian, Pangasinan, by Evermann and Seale.

It is found from the east coast of Africa, east to northern Australia, and north to Japan and Hawaii.

HENIOCHUS SINGULARIUS **Smith and Radcliffe. Plate 18, fig. 2.**

Heniochus singularius SMITH and RADCLIFFE, Proc. U. S. Nat. Mus. **40** (1911) 321, fig. 2; AHL, Chaetodontidae, 28, Archiv für Naturg. **89** (1893), Abt. A, Heft 5.

Dorsal XII, 26; anal III, 18; there are 58 scales in the lateral line; 12 between the lateral line and the origin of dorsal; 26 from the lateral line to the origin of anal. According to Smith and Radcliffe the scales are 11 + 26–50. Our specimen also has one more dorsal and anal ray than the number they give.

The upper profile of body has in front a small horn, directly above eyes; from this horn to origin of dorsal the profile is almost straight and from horn to tip of snout it is concave; body depth 1.5 times, head 3 times in length, the slightly convex interorbital space is 4 times in head, and has a bony projection over each eye; the snout rather long, 2.5 in head; the small circular eye 3.8 in head, its diameter slightly greater than the width of interorbital space; the edges of preopercle weakly denticulated; a rounded flat spine at posterior end of opercular bone.

Fourth dorsal spine longest, 2.2 in length of body and having a wide membrane behind; second and third anal spines nearly the same length, being equal to distance from tip of snout to vertical edge of preopercle; the tip of ventral does not extend to anus; the soft dorsal lower and more rounded than the soft anal, the middle rays of both fins highest.

Two small black bands, separated from each other by a narrow pearly white crossbar which extends from front of eyes to throat, encircle head just before posterior edge of eye; the first band encircles mouth and extends upward to nostrils, thus partly covering preorbital, and the second extends from top of head across eye, preopercle, and part of orbital ring to subopercle; the rest of body covered by alternating bands, the first one of which is yellowish silvery and descends from front of dorsal to throat; the second band of black covers almost all of trunk, ventrals and anal, and extends from the vertical through the insertions of dorsal and ventral to caudal peduncle, leaving a lighter area, widest ventrally and almost completely absorbed in the black, which extends downward from third to fifth dorsal spines to belly and anal; a well-defined yellowish white band covers caudal, a small part of caudal peduncle, the dorsal rays, and the upper portion of posterior dorsal spines; the pectoral black at base and yellowish white on the rest of the fin; lips yellowish white.

The above account is based upon the only specimen in the Bureau of Science collection. It was taken on the southern coast of Batangas Province by Japanese fishermen, and measures 184 millimeters in length. Since this was written a fine specimen, 204 millimeters in length, was collected at Quiminatin, one of the Cuyo Islands.

There is no question that the example at hand is identical with *Heniochus singularius* Smith and Radcliffe. This species is very closely related to *Heniochus varius* (Cuvier and Valenciennes), and a large series in all the growth stages might show their identity.

According to Smith and Radcliffe, the color in life is as follows: Upper portions of silvery bands on head, before described, slightly dusky, with a faint brassy wash; first and second dorsal spines black; third spine gray, the color continued as a lighter band diagonally across the black coloration of trunk to middle of anal; centers of scales on darker ventral portions of trunk somewhat pearly or purplish margined with darker brown; scales under posterior portion of dorsal black, particularly about margins, the centers with a steel bluish area, which becomes smaller toward base of anal; dorsal from tip of fifth spine to base of sixth and diagonally along its basal edge, including upper and hinder portion of caudal peduncle, and all of caudal fin, cadmium orange; front and posterior margins of anal purplish black; base of pectoral, including base of rays and all of the scaled portion, blackish, the remainder lemon yellow; ventrals black.

This species was obtained by Smith and Radcliffe on the Albatross Expedition from the following Philippine localities: Lagonoy and Ragay Gulfs, Luzon; Port Dupon, Leyte; Murcielagos Bay, Mindanao; and Ulugan Bay, Palawan. They also obtained it from Soo Wan, Formosa: Si Amil Island, eastern Borneo; Gulf of Tomini, Celebes; and Gilolo.

HENIOCHUS VARIUS (Cuvier and Valenciennes). Plate 20, fig. 2.

Taurichthys varius CUVIER and VALENCIENNES, Hist. Nat. Poiss. **7** (1831) 111, pl. 181; CUVIER, Règne Anim. Disciples' ed. **7** (1836) 109, pl. 41, fig. 2; BLEEKER, Atlas Ichthy. **9** (1878) 27, pl. 365, fig. 2; EVERMANN and SEALE, Bull. Bur. Fisheries **26** (1907) 97.

Heniochus varius GÜNTHER, Cat. Fishes Brit. Mus. **2** (1860) 41; AHL, Chaetodontidae, 24, Archiv für Naturg. **89** (1923) Abt. A, Heft 5.

Tao Sug name, *kabubu*.

Dorsal XI, 23 to 26; anal III, 17 or 18; there are 58 to 60 scales in the lateral line; 12 between the lateral line and the origin of dorsal, 24 to 26 from the lateral line to the origin of anal.

The dorsal profile has in front a hornlike projection which makes a concave outline with upper portion of head; depth 1.4 to 1.5 times, the small head 2.7 to 3.4 times in length; the interorbital space convex, 3.9 to 4.2 in head; over each eye is a very stout, long, sharp, outwardly curved, projecting spine, which may or may not have serrations on its hind side; there may or may not be strong serrations on upper and anterior portions of orbital margin; the snout 2.5 to 2.7 (exceptionally 3.6) in head, longer than eye, more concave in younger specimens; the circular eye 3 (2.8) to 3.3 (3.8) in head, its diameter shorter than snout; the opercle has a pointed flat spine behind; both the vertical and inferior limbs of preopercle finely serrated.

The fourth dorsal spine longest, 2.1 (1.5) to 2.3 times in length of body, with a filamentous tip and a wide membrane behind; the second and third anal spines nearly equal in length, the former much the stronger; the soft dorsal lower and more rounded than the soft anal; in the youngest specimen ventral extends to beyond base of anal spines, and in the oldest it scarcely reaches anus; the ventral spine equal to or slightly shorter than distance between snout and vertical limb of preopercle.

In alcohol the ground color yellowish white; a black band descends from front of dorsal and top of head to chin and throat, covering anterior two-thirds of sides of head; a second, very broad black band extends from third to seventh dorsal spines to underpart of body, reaching from root of ventrals to caudal peduncle and covering almost completely the sides, ventrals, and anal; a dark portion, which is a rather indistinct third band, is present on the dorsal fin rays; the base of pectoral black, rest of fin yellowish white; the caudal fin also yellowish white.

A specimen having only eleven dorsal spines has the fifth one the longest and the first one pointed forward.

We have studied eight specimens in the Bureau of Science collection. They measure from 107 to 141 millimeters in length and were obtained on the southern coast of Batangas Province; Calapan and Bulalacao Bay, Mindoro Province; Guindulman, Bohol; and Cagayan de Misamis, Mindanao.

The species occurs in Samoa and the East Indies, where it is common about the reefs.

HENIOCHUS PERMUTATUS Bennett. Plate 22, fig. 2

Heniochus permutatus Bennett in CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 75.

Heniochus chrysostomus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 75; Valenciennes, Poissons in CUVIER, Règne Anim., Disciples' ed. 8 (1836) pl. 40, fig. 2; LAY and BENNETT, Fishes, Voy. Blossom (1839) 62, pl. 18, fig. 1; GÜNTHER, Cat. Fishes Brit. Mus. 2 (1860) 41; Fische der Südsee 1 (1873–1875) 49, pl. 39, fig. A; STEINDACHNER, Sitzungsb. Wien 102, Abt. 1 (1893) 226, pl. 2, fig. 1; AHL, Chaetodontidae, 30, Archiv für Naturg. 89 (1923) Abt. A, Heft 5.

Taurichythys chrysostomus BLEEKER, Atlas Ichthy. 9 (1878) 29, pl. 366, fig. 4.

Dorsal XII, 22; anal III, 18; there are 52 scales in the lateral line, 11 between the lateral line and the origin of dorsal, and 22 to 25 from the lateral line to the origin of anal.

The dorsal profile nearly vertical in its upper part which extends forward over middle of eye; the small protuberant snout concave above; the greatest depth over base of ventrals, 1.5 to 1.6 times in length; the head small, 2.8 to 3 in length; the interorbital space nearly flat, 1.4 times in eye, with a short, sharp, outwardly pointed spine over each eye; in front of this spine is a trace of another, and behind are fine serrations on rim of orbit above eye; the circular eye is rather large, approximately 2.8 to 3 times in head, and equals snout; the opercle ends posteriorly in a sharp flat spine; the vertical limb of preopercle produced posteriorly and slightly serrated; the caudal peduncle small, its depth less than eye.

The fourth dorsal spine elongated, its length nearly two-thirds that of body, with filamentous tip and a wide membrane behind; the second and third anal spines nearly equal in length, the former much the stronger; the longest dorsal rays 1.4 times in the length of the longest anal rays; the pectoral is longer than head and extends as far as above second anal spine; the ventrals reach beyond anus.

Color in alcohol yellowish white with three transverse, somewhat curved, black bands descending obliquely backward, the first one from top of head and front of dorsal to belly, completely covering eye, upper portion of preopercle, opercle, base and axil of pectoral fin, and ventrals; the second from fourth to sixth dorsal spines down to anal rays; the third extends from the last five dorsal spines and covers base of dorsal rays and adjacent portion of body to or across root of caudal; the pectoral, soft dorsal rays, first three dorsal spines, anal spines, and caudal like body in color; the interorbital space and top of snout blackish.

We have but three specimens, 92 to 130 millimeters long, taken at Romblon, Romblon Island; and Tubigan and Bungau Islands, Sulu Archipelago.

This species is known to occur, although not abundantly, in the Moluccas, New Guinea, Tahiti, Samoa, and Woodlark Island.

Genus HOLACANTHUS Lacépède

Holacanthus LACÉPÈDE, Hist. Nat. Poiss. 4 (1803) 525.
Genicanthus SWAINSON, Class. Fishes 2 (1839) 212.
Centropyge KAUP, Wiegmann's Archiv 26 (1876) 138.
Acanthochætodon BLEEKER, Arch. Neerl. Sci. Nat. 12 (1876) 5.
Chætodontoplus BLEEKER, Arch. Neerl. Sci. Nat. 12 (1876) 26.

Common names.—English, angel fish; Tao Sug and Samal, *kabubu, teiro;* Visayan, *alibang-bang, boray-boray, tapay-tapay.*

This genus is distinguished at once from all other chaetodonts by the long, stout, usually grooved preopercular spine; the body is oval to subrhomboid, often robust, not greatly compressed; the scales are rather small, hard, ctenoid, longitudinally corrugate, often mixed with smaller ones; the head everywhere scaled; the vertical limb of preopercle has small equal serrations; the interopercle short, armed with 1 to 4 strong spines; the dorsal continuous, not notched, the spinous portion longer than the soft; dorsal spines 8 to 15, strong, usually graduated, increasing in height to the last; the soft dorsal with 15 to about 30 rays, usually rounded, sometimes angulate or pointed or the angle elongated into a filament; anal spines 3, the third one longer than the others, the rays 16 to 25, shaped like soft dorsal.

The members of this genus are among the most beautiful of living creatures. They vary in size, some of them becoming very large. They abound about coral reefs, usually at some depth; now and then some gorgeously colored specimen appears from the darkness below, sails majestically about for a time, and disappears in the caverns beneath. Some holacanthids are notable for their vivid hues, others in quieter garb have a richness and delicacy of coloration unsurpassed by the most beautiful of tropical butterflies. The larger species are prized for food, though rarely marketed.

Key to the Philippine species of Holacanthus.

a^1. Scales of moderate size, 35 to 50 in lateral series.
  b^1. Body with 3 to 5 longitudinal black bands; a yellow spot on nape; caudal and anal spotted with black .... **H. lamarcki.**
  b^2. Body without longitudinal bands.
    c^1. Body with 6 to 10 vertical crossbands.
      d^1. Dorsal with 13 spines.
        e^1. Body with 6 dark blue or violet-black bands; a pearl white band from nape to opercular spine behind eye. **H. sexstriatus.**
        e^2. Ten dark brown bands, the first through eye.. **H. multifasciatus.**
      d^2. Dorsal with 14 spines; body with 7 to 9 bluish bands, edged with violet-black, continued on dorsal; anal with longitudinal bluish bands .... **H. diacanthus.**
    c^2. Body without crossbands.
      f^1. Trunk with a large, vertical, pearl white spot near its middle. **H. tibicen.**
      f^2. Body bicolored, or uniform, or spotted.
        g^1. Body bicolored.
          h^1. Anterior portion of body and caudal yellow; rest of body black, sharply defined; soft dorsal and anal elongate, pointed; dorsal spines 15 .... **H. bicolor.**

h^2. Head and anterior two-thirds of body grayish brown, gradually passing into violet-black on posterior third; a large black blotch on hind margin of opercle; soft dorsal and anal rounded; dorsal spines 14 .... **H. vroliki.**

g^2. Body spotted.

i^1. Body orange brown with a dark blue ocellated spot on each side of nape and one on each shoulder.... **H. trimaculatus.**

i^2. Body deep orange yellow, each scale with a blue spot; head blue with yellow ocelli and bands on sides of head; a large black ocellus on posterior part of dorsal. **H. xanthometopon.**

a^2. Scales small, 75 to 95 in lateral series.

j^1. Body banded.

k^1. Body with many longitudinal, yellowish, slightly waved stripes. **H. imperator.**

k^2. Body with white curved transverse lines.

l^1. Scales 85 to 88; posterior line forming a complete ring; no longitudinal white line on middle of forehead...... **H. nicobariensis.**

l^2. Scales 75; lines curved, concentric, not forming a ring; a longitudinal white line from nape to tip of snout. **H. semicirculatus.**

j^2. Body not banded.

m^1. Dorsal spines 12 or 11; head and belly lemon yellow, shading to violet-brown or blackish on rest of body; sides with many irregular, wavy, longitudinal, blue lines; a brown ocular band from nape to breast.. **H. mesoleucus.**

m^2. Dorsal spines 14; accessory scales present; olive brown, darker anteriorly and posteriorly; each scale with a bluish or blackish spot; dorsal, anal, and caudal with pearly spots. **H. lepidolepis.**

HOLACANTHUS LAMARCKI Lacépède. Plate 16.

Holacanthus lamarcki LACÉPÈDE, Hist. Nat. Poiss. 4 (1798) 526, 532; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 148, pl. 184; BLEEKER, Atlas Ichth. 9 (1878) 59, pl. 371, fig. 4.

Dorsal XV, 15; anal III, 18; there are 45 scales in the lateral line, 7 between the lateral line and the origin of dorsal, and 23 between the lateral line and the origin of anal.

The laterally compressed body oblong-ovate, thick anteriorly but thin posteriorly, dorsal profile convex but with a depression before eye, anterior ventral profile convex; the depth of body twice, the head 3.7 times in length; the depth of head greater than its length; the eye 3.9 times in head, 1.2 times in snout, and 1.33 times in the convex interorbital space; the blunt, nearly vertical snout 3.18 times in head, the interorbital 2.9 times; the mouth small, horizontal, jaws equal, the preorbital partially conceals maxillary; it has two stout forward-pointed spines and its lower and posterior margin is strongly toothed; the maxillary 4.1 times in head; the nostrils close together, midway between eye and tip of snout, and directly in front of center of eye; the anterior nostril small, with a subtubulate margin which is elongate behind; the open posterior nostril larger; the posterior margin of preopercle diagonally inclined downward and forward, its posterior margin more or less coarsely serrate and terminating in a strong spine which is 1.55 times snout and a little more than twice in head.

The head, vertical fins, and caudal densely covered with small to minute scales; the regularly disposed scales of body moderately large except on breast, where they are much smaller; the conspicuous lateral line extends to base of caudal; the base of spinous dorsal more than twice as long as that of soft dorsal; the last dorsal spine equals snout and eye together; the dorsal rays longer than the dorsal spines, the middle rays longest, acutely angulate; the anal shaped like soft dorsal, its angulate portion of equal length; the upper and lower marginal lobes of caudal prolonged into filaments, the total length of caudal 3 times that of head; the pectoral a little shorter than head.

The color violet-brown above, merging into sea green or blue-green on sides, pale below, with a dilute roseate flush over all, becoming light rose on breast and cheeks; 5 longitudinal black bands, the first 2 starting from eye, the next 2 on cheek below eye, all 4 pursuing a slightly irregular course, breaking into spots posteriorly and terminating on base of caudal; the fifth line short, extending from beneath pectoral to a point above middle of anal; a yellow spot on nape; a broad deep black band includes the 4 anterior dorsal spines and passes back to angle of soft dorsal as a broad black margin; the anal and caudal covered with small black spots; the ventrals deep black; the eye yellow. In alcohol the rose and green largely disappear, and the green spots on the lateral scales change to pearl color.

Here described from a specimen, 130 millimeters long, collected on the coast of Tablas.

This unique species hitherto has been known only from the Moluccas. According to the early Dutch writers on the Moluccan fauna this fish is highly prized, its flaky flesh having a very agreeable flavor.

HOLACANTHUS SEXSTRIATUS (Kuhl and Van Hasselt) Cuvier and Valenciennes.

Holacanthus sexstriatus (Kuhl and Van Hasselt) CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 145; GÜNTHER, Cat. Fishes

2 (1860) 49; KNER, Zool. Reise Novara, Fische (1865) 104; BLEEKER, Atlas Ichth. 9 (1878) 66, pl. 372, fig. 1.

Dorsal XIII, 20; anal III, 18; there are 50 scales in a lateral series, 9 between the lateral line and the origin of dorsal, and 30 between the lateral line and the origin of anal.

The body oval, deep and compressed, its depth contained 1.7 to 1.8 times in length; the head a little shorter than deep, 2.1 to 2.2 times in depth of body, its upper profile steep and very slightly arched to upper end of maxillary; the depth of caudal peduncle 6.7 to 7.5 times in length of body or almost twice in that of head, and less than twice its own depth; the circular eye contained from 4 to 4.7 times in length of head or about twice in that of snout, which is 2.3 to 2.4 times in head; the interorbital space strongly and evenly convex, rather wide, being 2.9 to 3.2 times in head; the maxillary much shorter than snout and from 3 to 3.5 times in head; the mouth small and oblique, with the upper jaw narrowly slipping behind into a groove under anterior edge of preorbital; the preorbital provided with a few small but strong blunt teeth at its widest portion, which is as wide as interorbital space; the anterior nostril is a very small rounded opening, with a marginal flap all around except at anterior border, and leads into the same cavity as the exceedingly large oval posterior nostril. One specimen is abnormal, having two small anterior nostrils on the right side of head, in front of the much larger posterior one; the other side is normal; the preopercle is evenly serrated behind, armed below with small, widely separated teeth, and has at its angle a long, stout, slightly curved spine, which is twice in length of head; opercular margin entire.

The scales large and regular, those on head and fins small to minute; there are no accessory scales anywhere on body except a few on breast; the lateral line is very distinct and ends at base of caudal fin; the dorsal spines progressively higher to the last, which is twice the length of snout; the posterior margin of soft dorsal almost forms a right angle with upper margin; the anal rounded posteriorly, the caudal convex; the short pectoral longest superiorly and about as long as last dorsal spine, its posterior margin within three scales of anus; the ventral fin is longer than the pectoral by an eye diameter and reaches origin of anal, its spine 1.4 in head.

The life color yellowish brown with a large dark blue center to each scale of body, leaving a light edge which forms the ground color; across the dark blue head there is a broad pearl white vertical band descending from nape to base of opercular spine, passing between eye and posterior preopercular margin; the body crossed by six dark blue vertical bands; the preopercular spine and the dorsal spines blue; the vertical and caudal fins yellowish brown with a bluish margin, a submarginal border of blue-black and many good-sized circular bluish white spots thickly sprinkled upon soft dorsal, anal, and caudal.

In alcohol the ground color has become yellowish; the head, breast, all the fins, and the vertical bands across body have turned violet-black; the pearl white band on head has become dull white; the bluish white spots and external margins on vertical and caudal fins are still present, and the submarginal border of blue-black is rather conspicuous; each scale of body blackish, leaving a whitish or yellowish border.

We have studied four examples, 167 to 300 millimeters long, collected at Ambil Island in the China Sea, southwest of Manila Bay and just north of Lubang Island; Tagapula Island, Samar; Bantayan Island, Cebu; and Tandubas Island of the Tawitawi group, Sulu Archipelago. A very large specimen was seen at Cebu but the fisherman refused to sell it, saying he wished to eat it.

This species, not heretofore reported from the Philippines, is easily recognized by the presence of thirteen dorsal spines, the pearl white crossband on each side of head, and the six dark vertical bands across body. It reaches a length of at least half a meter and is said to be the largest *Holacanthus*. It is only known from the East Indies.

HOLACANTHUS MULTIFASCIATUS Smith and Radcliffe. Plate 17, fig. 2.

Holacanthus multifasciatus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus. 40 (1911) 324, fig. 3.

Dorsal XIII, 17; anal III, 16; scales in lateral line 46, in transverse series 7 + 22; 30 rows between opercle and end of last vertebra.

The general form elliptical, the body compressed, the depth 1.55, the head 3.25 times in length; the upper profile steep, somewhat sinuous but nearly straight; the snout short and blunt, 2.75 times, the eye 3.1 times, the flattened interorbital 3.5 times in head; the mouth small, terminal; the preorbital armed with several strong, sharp denticulations; the anterior nostril has a posterior flap, the posterior nostril is elliptical; the vertical limb of preopercle has well-developed denticulations; the spine at the angle is strong, curved, longer than snout; two weaker spines on the horizontal limb; the scales regularly arranged, those on middle of side larger than the others; vertical fins and head finely scaled; the dorsal spines slender, curved, the fifth longest, 1.46 times in head; the membranes of the anterior spines deeply incised; the soft dorsal higher than the spinous dorsal, evenly rounded; anal similar to soft dorsal; the caudal short, the tip rounded; the ventrals 2.65 in length, the first ray filamentous, its tip reaching base of second anal spine; pectoral slightly longer than head.

Color in life: Ground color pearl gray, paler below, crossed by ten dark brown bands merging into orange ventrally, bands slightly wider above than below, slightly narrower than eye in widest part, and about equal to interspaces; the first or ocular band is orange below eye; there is an orange ring about mouth, the snout and chin dusky; a short brown stripe between the eyes; a black blotch near middle of brown margin of soft dorsal; bands on anal mostly orange; ventrals cadmium yellow, the produced tip white; pectorals hyaline.

Color in alcohol: Dusky cream, crossed by ten seal brown, somewhat curved crossbands about as wide as the interspaces; the first or ocular band slightly narrower than eye, crosses nape in front of dorsal and extends downward across base of preopercular spine, fading out on breast; second band extends from first and second dorsal spines downward across posterior border of opercle and pectoral base, traces reaching behind base of ventral; third to eighth bands begin on spinous dorsal, the seventh and eighth crossing anterior basal portion of soft dorsal, and extend downward across base of anal; ninth band crosses tips of last two dorsal spines, middle of soft dorsal rays, anterior part of caudal peduncle, and middle of anal rays; tenth band crosses upper third of soft dorsal, base of caudal peduncle, and posterior third of anal; traces of another band on tip of soft dorsal rays, base of caudal, and tips of anal rays; a short median stripe on top of head, widest between eyes; traces of a dusky brown band around mouth; caudal with five crossbands, the first complete, the others successively more broken; anal spines and ventrals white; pectoral dusky.

The Albatross Expedition obtained specimens at Puerto Galera, Mindoro, and Romblon, in the Philippines, the type, 93 millimeters long, coming from the first-named locality. Other specimens were collected at Mabul Island, Borneo; at four islands in Tomini Gulf, Borneo; and Bouro, Talisse, and Uki Islands in the Dutch East Indies.

The above description is compiled from Smith and Radcliffe's account, as we have not found this little *Holacanthus*.

HOLACANTHUS DIACANTHUS (Boddaert). Plate 21, fig. 2.

Chætodon diacanthus BODDAERT, Efist. de Chaetodonte diacantho descripto (1772) Schrift, Ges. Naturf. Freunde, Berlin 3 (1782) 459.

Holacanthus diacanthus GÜNTHER, Cat. Fishes 2 (1860) 48; Fische der Südsee 1 (1873) 50, pl. 40, fig. A; BLEEKER, Atlas Ichthy. 9 (1878) 65, pl. 348, fig. 5; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 347.

Chætodon fasciatus BLOCH, Ichtyologie 6 (1788) 39, pl. 195 (figure very poor).

Holacanthus dux LACÉPÈDE, Hist. Nat. Poiss. 4 (1803) 534; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 138.

Dorsal XIV, 20; anal III, 18; there are 44 scales in a lateral series, 8 between the lateral line and the origin of dorsal, and 27 between the lateral line and the origin of anal.

The body oblong-ovate, with the dorsal and ventral profiles about equally elevated, its depth contained 2.1 times in length; the head, which is as long as deep, 3.3 times in length of body, its upper profile slightly concave in front of eye and gently arched above it toward dorsal fin; the depth of caudal peduncle less than twice its length, 8.7 times in length of body; the almost flat interorbital as wide as the diameter of the high, circular eye, which is 3.8 times in length of head; the snout rather pointed and long, 2.4 times in head; the maxillary much shorter than snout and contained 3.4 times in head; the mouth small and horizontal, with the jaws even and maxillary partly covered by anterior portion of preorbital; the preorbital armed with small teeth on its lower edge and almost equal to an eye diameter at its widest part; in front of eye are two nostrils, the slightly larger one behind a simple oval opening, and the anterior one surrounded by a very short membranous tube which is extended behind into a very wide flap; the preopercle is coarsely denticulated behind and has at its angle a stout, slightly curved spine, which is a little shorter than eye; in front of this spine along lower edge of preopercle are several small, sharp teeth; opercular margin not serrated.

The scales moderately large and regular in size and shape, those on trunk in regular transverse lateral series; there are no accessory scales; the conspicuous lateral line ends at posterior third of soft dorsal; the dorsal spines evenly graduated to the last, which is the longest and contained about twice in depth of body; the rayed dorsal and anal fins rounded and about equal in height; the caudal fin strongly convex; the pectoral, which is longest superiorly, ends before anal opening; the ventral is slightly produced and extends behind as far as anus.

In alcohol the ground color yellowish, with ten bluish transverse bands, each broadly edged with violet-black; the first eight bands continued on dorsal; the ninth across caudal peduncle; the tenth across base of caudal fin; on anal are several bluish streaks, which run parallel to base of fin; caudal entirely yellowish; there are two transverse bands, edged with violet-black on each side of head, one behind orbit and the other in front of it; running along middle of forehead is another band similarly colored.

The single specimen above described is a ripe female, 122 millimeters long, collected at Romblon in August, 1922.

Since writing the above a specimen, 157 millimeters long, was obtained at Bantayan Island. In life the upper half of body is brilliant orange, merging into lemon yellow ventrally and on caudal, the body crossed by ten wide, curved, pale blue bands, each surrounded by a thick brownish black stripe; the bands extend above upon dorsal, the black borders extend back as longitudinal lines on fin; a blue-black-edged stripe extends from first transverse band to nape and down to and around behind eye, terminating beneath it; another blue line begins lower down on median line of head and extends to and around in front of eye, where it terminates; a blue line extends from middle of interorbital to tip of snout; the head is smoke gray, becoming blackish above eye and slightly tinted with yellowish posteriorly, the lips bright yellow, the posterior margin of opercle, preopercle, and preopercular spine blue; the breast pale smoke gray; the posterior part of dorsal brilliant indulin blue, sprinkled with pale blue dots and dashes; the dorsal has a pale blue margin, more deeply colored posteriorly; within this is a black stripe, followed by a yellow stripe; the anal rufous with curved longitudinal bands of pale blue edged with darker blue lines, the margin blue; the posterior margin of caudal orange, the ventral lemon yellow, the pectoral martius yellow.

This brilliant and exceedingly gaudy fish seems to be rare in Philippine waters.

The Museum of the Ateneo de Manila contains a specimen from Baganga, Mindanao.

This well-marked fish has been reported from Manila by Jordan and Seale; it ranges from the Red Sea and Zanzibar to Polynesia and is very common about the coral reefs of Samoa.

HOLACANTHUS TIBICEN (Cuvier and Valenciennes). Plate 20, fig. 1.

Holacanthus tibicen CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 130; GÜNTHER, Cat. Fishes 2 (1860) 46; BLEEKER, Atlas Ichthy. 9 (1878) 62, pl. 370, fig. 4; WEBER, Fische Siboga Exp. (1913) 312.

Holacanthus leucopleura BLEEKER, Nat. Tijd. Ned. Ind. 5 (1853) 79.

Centropyge tibicen KAUP, Wiegmann's Archiv Naturg. 26^1 (1860) 138.

Dorsal XIV, 16; anal III, 17; there are 35 scales in a lateral series, 8 between the lateral line and the origin of dorsal, and 20 between the lateral line and anal.

The depth of the slightly elongate, oblong-ovate body contained 1.8 to 2 times in length; the anterior dorsal profile from below nostrils to origin of dorsal fin steep and a little arched and with the ventral outline from lower jaw to caudal peduncle evenly curved; the head as long as deep, 3.1 to 3.4 times in length of body; the depth of caudal peduncle nearly twice its length, 6.4 to 6.6 times in length of body; the interorbital space strongly convex, 3.1 to 3.5 in length of head; the maxillary slightly shorter than an eye diameter and 3.5 to 3.9 in head; the circular eye rather small, 3.1 to 3.8 times in head; the bluntly rounded snout moderately long, 2.3 to 3.4 times in length of head; the mouth small and horizontal, with the jaws even; the upper portion of maxillary slips into a groove under front part of interorbital, which is nearly as wide as eye at its widest portion and serrated at its lower edge; two nostrils of about the same size very near each other in front of eyes, the front one in a tube which is much produced behind, and the posterior one a simple rounded opening; the preopercle has at its angle a long, stout, slightly curved spine, which reaches to base of pectoral fin; above this spine is strongly serrated and in front of it are one or more small, sharp spines; there are small, sharp teeth also on the outer margins of interopercle and subopercle; the opercle unarmed.

The scales moderately large, in regular transverse and longitudinal series on body; accessory scales absent; the dorsal, anal, and caudal densely scaled; the lateral line well marked, extending along back near base of dorsal and disappearing near end of dorsal fin; the dorsal spines gradually longer to the last, which is 2.2 to 2.8 times in depth of body; the rayed dorsal rather angular, the soft anal and caudal obtusely rounded; the pectoral fin is longest and rounded above, extends to a little behind anus, and is a little shorter than the ventral, the tip of which is at base of anal spines.

In alcohol the ground color is blackish violet, with a large, vertically oblong, pearl white spot between lateral line and posterior half of pectoral; the anal fin has a rather wide yellowish border anteriorly, its remaining portion and all the other fins blackish violet.

The foregoing account is based upon four examples, 62 to 102 millimeters long, from Tubigan, Jolo, and Sibutu and Sitankai Islands, Sulu Archipelago. This is the first record of the species from the Philippines.

Elsewhere it is known only from the seas of Celebes and the Moluccas. The senior author found it to be common in shallow water on coral reefs in the Tawitawi and Sibutu Island group.

The type specimen, originally preserved in the Leyden Museum but no longer in existence, was from an unknown locality and had the anal formula IV–16. Bleeker found individuals with 13 and 15 dorsal spines, and the presence of 4 anal spines is likewise merely an individual variation. The nacreous lateral spot is also subject to great variation.

HOLACANTHUS BICOLOR (Bloch).

Chætodon bicolor BLOCH, Ichtyologie 6 (1788) 70, pl. 206, fig. 1 (figure only).

Holacanthus bicolor CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 126; GÜNTHER, Cat. Fishes 2 (1860) 50; Fische der Südsee 1 (1873) 51, pl. 39, fig. B; BLEEKER, Atlas Ichth. 9 (1878) 61, pl. 369, fig. 3; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 348; Bull. Bur. Fisheries 26 (1907) 34; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 269.

Dorsal XV, 16 or 17; anal III, 18 or 19; there are 48 or 50 scales in the lateral line, about 24 between the ventral spine and the first dorsal spine.

The depth of the ovate oblong body 2.5 to 2.75 times, the obtuse head 4 to 5 times in length, including caudal fin; the diameter of eye 3 to $3\frac{1}{3}$ times in head; the interorbital space three-fourths of or equal to eye; the preorbital bone conspicuously denticulate; the preopercle conspicuously serrate on its posterior margin, the spine at its angle reaching to base of pectoral but less than twice eye; the interopercle conspicuously serrate with subspinous teeth; the scales on trunk more or less irregularly arranged, many with secondary scales on base; the scales on head very small; the spinous dorsal a little more than twice as long as soft dorsal, the spines increasing in length posteriorly, the last shorter than head without snout; the soft dorsal much higher than spinous dorsal or than its own length, the central rays longest and produced into an acute point; the pectoral acute or acutely rounded, equal to or scarcely shorter than head; the third anal spine shorter than head without snout, the rays elongate, of the same shape and approximate length as soft dorsal; the convex caudal equal to or scarcely shorter than head; the first ventral ray more or less elongate, a little shorter than or equal to head.

The color of anterior part of body and fins to a vertical from sixth or seventh dorsal spine a beautiful orange or lemon yellow; the posterior part to a little before base of caudal, anal, and rest of dorsal violet-black, blue-black, or deep black; the remainder of caudal peduncle and caudal fin like anterior part of body; a broad black or blue-black supraocular band shaped like a horse's hoof descends on each side to eye; sometimes the cheeks are dusky or brown; the scales on the black portion of body may have transverse pearly or blue stripes; the dorsal fin partly punctate with black, the anal with spots and short irregular stripes of blue.

The above description is compiled, as we have no specimens. For more than half an hour the senior author watched some specimens of this species, one of them at least 300 millimeters long, as they swam about the dock at Bato Bato, Tawitawi Island. The species has been recorded from Manila by Jordan and Seale, and was collected at Cagayancillo by McGregor.

This species occurs from Sumatra to New Guinea and the Solomon Islands, and in the South Pacific at Samoa. A Hawaiian record is dubious. Bloch's plate shows the species, but his description is confused with that of the very similar West Indian species, *H. tricolor*.

HOLACANTHUS VROLIKI Bleeker. Plate 22, fig. 1.

Holacanthus vroliki BLEEKER, Nat. Tijd. Ned. Ind. 5 (1853) 339; GÜNTHER, Cat. Fishes 2 (1860) 51; KLUNZINGER, Syn. Fische des Rothen Meeres, Verh. Zool. Bot. Ges. Wien 20 (1870) 787; BLEEKER, Atlas Ichth. 9 (1878) 63, pl. 371, fig. 1.

Dorsal XIV, 15 to 17; anal III, 15 to 17; there are 36 to 38 scales in a lateral series, 7 between the lateral line and the origin of dorsal and 20 to 23 between the lateral line and the origin of anal.

The compressed, oblong-ovate body contained 1.7 to 2 times in length, with the profiles about equally elevated; the head a little shorter than deep, its length 3.2 to 3.4 times in length of body or 1.7 to 2 times in its depth; the depth of caudal peduncle about twice its length, and 6.5 to 7.1 times in length of body or 2 to 2.2 times in length of head; the interorbital space evenly and strongly convex, its width from 3.1 to 3.6 times in head; the eye circular, moderate in size, 2.6 to 3.5 times in length of head; the fairly short, bluntly rounded snout 1.1 to 1.3 times maxillary, which is contained from 3.1 to 3.7 times in head; the mouth small and almost horizontal, with both jaws nearly even; the preorbital, which is nearly equal to eye at its widest portion, almost wholly covers maxillary in front, its inferior margin strongly serrated; there are two rounded nostrils of about equal size in front of eye, the anterior one with a marginal flap which is very much extended behind and the other with a very low flap on its hind margin only; the preopercle is strongly serrated behind and has at its angle a long, stout, slightly pointed spine which is longer than snout and extends to base of pectoral; at the base of this spine is a strong sharp spine; the interopercle armed with two or more small, sharp spines behind; the subopercle strongly toothed below, the opercle entire.

The scales large and regular, those on fins very small and dense; the conspicuous lateral line terminates at base of caudal fin; the dorsal spines rather high and slender, those along the middle about as long as the posterior ones; both the rayed dorsal and anal rounded posteriorly; the caudal strongly and evenly convex; the pectoral fin is produced and slightly rounded superiorly, and extends to a little behind anus; the pointed ventral terminates at origin of anal fin.

The head and the anterior two-thirds of body grayish brown, this color gradually passing into violet-black on posterior third and on caudal and soft vertical fins; a transverse whitish streak on each scale, and a large black blotch on hind margin of opercle; the pectoral, ventral, and spinous dorsal fins grayish brown; the posterior margin of caudal narrowly edged with white.

Nine specimens in the Bureau of Science collection form the basis of the above description. They range in length from 45 to 75 millimeters, and were taken at Calapan, Mindoro; Cagayan de Misamis, Mindanao; and Tambagaan and Bungau

Islands, Sulu Archipelago. Two of them, 62 and 75 millimeters long, collected in January, 1923, are ripe females.

This species, which has not been reported previously from the Philippines, ranges from the Red Sea to the Moluccas. It resembles closely the *Holacanthus nox* of Bleeker in general coloration and form, but is distinct in the details of color markings, and in the presence of rounded vertical fins, relatively higher dorsal and anal spines, and a smaller number of spines on the dorsal fin.

HOLACANTHUS TRIMACULATUS Lacépède. Plate 21, fig. 1.

Holacanthus trimaculatus Lacépède apud CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 147, pl. 182; GÜNTHER, Cat. Fishes 2 (1860) 50; PLAYFAIR and GÜNTHER, Fishes of Zanzibar (1866) 38; BLEEKER, Atlas Ichthy. 9 (1878) 63, pl. 373, fig. 5.

Dorsal XIII or XIV, 18; anal III, 18; there are 45 scales in a lateral series, 10 between the lateral line and the origin of dorsal, and 27 or 28 between the lateral line and the origin of anal.

The greatest depth of the ovate, compressed body 1.7 to 1.8 times in length; the head slightly shorter than its depth and contained from 3.3 to 3.6 times in length of body, its upper profile steep and nearly straight; the caudal peduncle rather short and much compressed, deeper than long, its depth 6.8 to 7.2 times in length of body or about twice in head; the wide, moderately arched interorbital is 3.2 to 3.4 in length of head and bulges a little on upper profile of head, forming a slight depression in front and above eyes; eye almost circular, fairly large, its diameter from 3.7 to 4.1 times in head and equal to or slightly shorter than length of maxillary, which is contained 3.7 to 3.9 times in head; the snout bluntly rounded at tip, moderately long, 2.4 to 2.7 times in head; the mouth small, its gape almost horizontal; jaws equal, the upper one slipping behind into a groove under preorbital; the nostrils small and placed together in front of orbit, the anterior one in a tube which is prolonged into a small triangular flap, and the posterior one with a flap all around except at its hind portion; the preorbital has a few small but strong teeth in front of eye at its widest portion, and below this it is almost as wide as diameter of eye; the posterior and inferior edges of preopercle weakly denticulated, and at its angle there is a long, stout, slightly curved spine which equals head without snout; the denticulations of both interopercle and subopercle hardly conspicuous; the opercle entire.

The sides of body covered with large scales, those above the lateral line and on sides of abdomen smaller; accessory scales present, especially forward and above; the scales on head and fins very small to minute; the lateral line is conspicuous and terminates a little below axil of dorsal; the dorsal spines increase in length to the last, which is contained from 1.4 to 1.6 times in length of head and is slightly shorter than second anal spine; the soft dorsal rounded posteriorly, the seventh and eighth rays longest; the anal slightly pointed behind, its ninth and tenth rays longest, the anal extending a little farther posteriorly than soft dorsal; the pectoral and ventral fins about equal in length, the former ending before anus while the latter just extends to it; the caudal fin convex and about as long as pectoral.

In life the ground color is brilliant brownish orange, fading into lemon yellow on breast and belly, and into bluish white near base of anal fin; a dark blue ocellated spot on each side of nape, and a larger one on each shoulder, the spots ringed with pale yellow, the lips and the large preopercular spine dark blue; the dorsal, caudal, and ventral colored similarly to body; the pectoral lemon yellow on its outward portion and brownish yellow toward base; the anal spines and outward half of anal bluish black, the rest of the fin bluish white.

In alcohol the color has turned darker, leaving a whitish or yellowish center on each scale; the lips, and the spots on nape and shoulder have become blackish, the yellow ring about each fading to whitish; the white color on lower portion of body near base of anal fin and on upper half of anal rays has disappeared; the lower half of anal black, the other fins colored similarly to body.

Here described from three specimens, 132.5 to 157.5 millimeters long, collected at Maricaban Island, Batangas; Sayan Island, Samar; and Jolo, Sulu Province. The smallest specimen is a ripe female, collected at Sayan Island in February, 1925.

The name *trimaculatus* is a misnomer for this fish, in as much as there are four ocellated spots present instead of three as given by Cuvier and Valenciennes. The species is rare and has been reported from Zanzibar and the Moluccas.

HOLACANTHUS XANTHOMETOPON Bleeker.

Holacanthus xanthometopon BLEEKER, Nat. Tijd. Ned. Ind. 4 (1853) 258; Atlas Ichth. 9 (1878) 64, pl. 371, fig. 2; GÜNTHER, Cat. Fishes 2 (1860) 51; DAY, Fishes of India (1878) 114.

Dorsal XIV, 17; anal III, 17; 47 scales in lateral series, 7 between the lateral line and the origin of dorsal, and 25 between the lateral line and anal.

The depth of the thick, laterally compressed, oblong body about 1.9 times in length; the anterior profile descends very steeply from origin of dorsal to base of upper lip, the short upper lip projecting strongly in a short abrupt curve so that the fish has a marked snub nose; the blunt head 4 times in length; eye 4.4 times in head, 1.6 times in the broad convex interorbital, and 1.9 times in the short blunt snout, which is 2.3 times in head; the strong preopercular spine 1.77 times eye and 2.5 times in head; posterior margin of the steeply inclined preopercle finely serrate; about 43 rows of scales from angle of gill opening to base of caudal; about 30 scales in transverse series from first dorsal to ventral spine and 7 between lateral line and first dorsal spine; the soft dorsal and anal fins obtusely rounded; depth of caudal peduncle 1.93 times in head, 7.83 times in length; the convex caudal 1.25 times in head; the broad pectoral 0.88 of head; the ventral narrow, pointed, very elongate, extending to base of anal, 2.4 times in length.

In alcohol each scale has a blue or violet-black spot, edged with bright yellow, the spots very small on breast and the yellow very prominent; a wide yellow band between and including eyes; rest of head blue-black, with numerous small yellow spots on sides; a small yellow spot behind angle of gill opening; dorsal, caudal, and pectoral clear bright yellow, with a large blue-black spot on posterior dorsal rays; ventral very dark blue or violet, merging into yellow on posterior rays, the rays thickly sprinkled with small circular blue dots; the soft dorsal, anal, and caudal each edged with a black line; a blue-black margin on upper side of pectoral; ventrals very deep blue.

This very beautiful fish is here described from a specimen, 242 millimeters long, collected on a reef at Quiminatin Island, one of the Cuyo Islands. The senior author saw a much larger specimen in Cebu, but the fisherman refused to sell, saying he wanted to eat it.

The color of living or fresh specimens similar to that given, but the blue or violet and yellow much brighter.

This angel fish has been recorded from Sumatra, Goram, Waigiou, and the Andaman Islands.

HOLACANTHUS IMPERATOR (Bloch). Plate 23, fig. 2.

Chætodon imperator BLOCH, Ichtyologie 6 (1788) 38, pl. 194.

Holacanthus imperator CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 135; GÜNTHER, Cat. Fishes 2 (1860) 52; PLAYFAIR and GÜNTHER, Fishes of Zanzibar (1866) 38; KLUNZINGER, Fische des Rothen Meeres 1, Verh. Zool. Bot. Ges. Wien 20 (1870) 787; GÜNTHER, Fische der Südsee 1 (1873) 53, pl. 41, fig. A; DAY, Fishes of India (1878) 112, pl. 28, fig. 5.

Acanthochaetodon imperator BLEEKER, Atlas Ichth. 9 (1878) 70, pl. 367, fig. 2; pl. 374, fig. 4.

Dorsal XIV, 20 to 22; anal III, 19 to 21; there are 88 to 93 scales in a lateral series, 15 or 16 between the lateral line and the origin of dorsal, and about 36 between the lateral line and the origin of anal.

The depth of the ovoid, markedly thick body from 1.6 to 1.9 times in length; the head from 3.4 to 3.8 times or nearly as long as deep, its dorsal outline slightly and unevenly concave; the caudal peduncle much deeper than long, its depth 7 to 8.5 in length of body; the interorbital space strongly arched, narrowest in front of eyes, 3 to 3.4 times in length of head; the eye almost circular and contained 1.7 to 2 times in the length of the bluntly rounded snout, which is 2.2 to 2.3 times in head; the maxillary longer than diameter of eye and from 3.2 to 3.4 in length of head; the mouth small and oblique, with the jaws even and the premaxillary slipping into a groove under the front edge of the finely serrated preorbital; two simple rounded nostrils of nearly equal size close together in front of each eye, the more anterior having a marginal flap above; the preopercle armed at its angle with a long, stout, slightly curved spine which reaches to base of middle pectoral rays, and is serrated above and in front of this spine; the suboperculum weakly denticulated; both opercle and interopercle unarmed.

The scales very small, those on head numerous and very small to minute; accessory scales pretty evenly distributed all over body; the lateral line plainly visible on tail, and rather inconspicuous on rest of body; the dorsal spines gradually become longer posteriorly, the last one being as long as head from anterior edge of preorbital to hind extremity of opercle; the soft dorsal produced posteriorly into a filament, which extends beyond tip of caudal fin; the anal fin broadly rounded, the caudal fin markedly convex; the tip of the short and somewhat rounded pectoral does not reach to anal opening; the outer ray of ventral is filamentous and ends posteriorly beyond anus, the ventral spine a little more than half the length of head.

In alcohol the ground color varies from violet-brown to violet-black, becoming much darker ventrally and on outward portion of anal, with more brown on breast and belly, and more black on anal fin; the body has many yellowish, longitudinal, slightly waved stripes; a curved black band, convex behind and edged with bluish white, runs across interorbital through eyes and tapers to a point at base of preopercular spines; a large oblong black spot, edged anteriorly with bluish white and posteriorly with yellowish, lies between shoulder, opercle, and root of pectoral; the dorsal and anal fins narrowly edged with bluish white, the former yellowish on its outward portion; the caudal entirely yellowish; the pectoral violet-black toward base and yellowish behind; the ventral brownish, with an indication of the presence of longitudinal bluish white stripes on its membranes; the lips bluish white.

The six examples above described vary from 102.5 to 280 millimeters in length, and were taken at Calapan and Puerto Galera, Mindoro, the southern coast of Batangas Province, and Basbas Island, Sulu Archipelago. Three specimens were collected at Puerto Galera, some time between March and May, 1912; one of them, 223 millimeters long, is a female about ready to spawn. There is no previous record of this species from the Philippines.

This beautifully and distinctly marked fish was named "The Emperor of Japan" by the early Dutch explorers and naturalists in the East Indies. According to them it was the most highly esteemed fish in the Moluccas, its flesh comparable with that of the salmon, and commanded a very high price. This very showy holacanthid occurs from the Red Sea and Zanzibar to the Society Islands in the South Pacific, but does not seem to be abundant anywhere.

HOLACANTHUS NICOBARIENSIS (Bloch and Schneider).

Chætodon nicobariensis BLOCH and SCHNEIDER, Syst. Ichth. (1801) 219, pl. 50.

Holacanthus nicobariensis GÜNTHER, Cat. Fishes 2 (1860) 52; Fische der Südsee 1 (1873) 54; DAY, Fishes of India (1878) 112, pl. 28, fig. 6; VAILLANT, Nouv. Arch. Mus. Paris III 5 (1893) 58.

Acanthochætodon nicobariensis BLEEKER, Atlas Ichth. 9 (1878) 69, pl. 365, fig. 1.

Dorsal XIII or XIV, 19 to 21; anal III, 19 or 20; there are 85 to 88 scales in a lateral series, 13 or 14 between the lateral line and the origin of dorsal, and 36 to 40 between the lateral line and anal.

The depth of the oval, much compressed body 1.8 times in length, its anterior dorsal profile evenly arched; the head 2.8 to 3.1 times in length of body; the depth of the strongly compressed and short caudal peduncle 8.3 to 8.4 times or 2.7 to 2.9 times in length of head; the slightly and evenly arched interorbital contained from 3.5 to 3.9 times in head; the circular, moderately large eye 2.7 to 3.2 times; the rounded, short snout 3.1 to 3.2 times and equal to or slightly longer than maxillary which is contained from 3.2 to 3.3 times in head; the mouth small and slightly oblique, with the lower jaw a trifle in advance of the upper which is partly covered behind by the denticulated portion of preorbital; the nostrils small and close together in front of eyes, the anterior rounded one with a marginal flap which is much wider behind, and the posterior ovate one a simple opening; the preopercle has at its vertical limb very fine serrations, below which is the long, stout, slightly curved spine which is shorter than an eye diameter; the interopercle armed inferiorly with small sharp teeth; the edges of both opercle and subopercle smooth.

The scales of body rather small and regular in form, those covering head and fins very small to minute; accessory scales absent; the dorsal spines evenly graduated to the last, which is the highest and about equal to half the depth of body; the caudal and soft vertical fins are rounded, the pectoral extends to anus and the outer ray of vertical is produced into a filament which ends posteriorly at base of anal spines.

In alcohol the ground color is violet-black, with curved, alternately broad and narrow white lines, the posterior of which forms a complete ring; on dorsal, anal, and caudal fins the lines are more or less divided and reticulated; on each side of head are three wide vertical white lines, one touching hind margin of orbit, the second descending from suborbital to interopercle, and the third crossing angle of mouth and uniting with the opposite line on the other side at tip of snout; a broad horizontal white line crosses interorbital from eye to eye; there is no longitudinal white line running along middle of forehead; the posterior half of caudal white.

The above description is from two examples, 29 and 67 millimeters long, from Guam.

The senior author for some time had a living specimen from Calapan, Mindoro, but it was not preserved when it died, so that our collection contains no Philippine specimen at present. Elsewhere it ranges from the East Indies to the Ladrone and Society Islands.

This fish is easily distinguished from *Holacanthus semicirculatus* by the more-curved lines on posterior part of body, by the short transverse line passing from eye to eye, and by the higher scale count.

HOLACANTHUS SEMICIRCULATUS Cuvier and Valenciennes. Plate 19, fig. 1.

Holacanthus semicirculatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 143, pl. 183; LESSON, Voy. Coquille, Zool., Poiss. 2 (1830) 173, pl. 30, fig. 3; GÜNTHER, Cat. Fishes 2 (1860) 53; WEBER, Fische Siboga Exp. (1913) 311.

Holacanthus striatus RÜPPELL, Neue Wirbelt. Fische (1838) 32, pl. 10, fig. 2; GÜNTHER, Cat. Fishes 2 (1860) 53.

Acanthochætodon semicirculatus BLEEKER, Atlas Ichthy. 9 (1878) 69, pl. 370, fig. 5.

Dorsal XIII, 22; anal III, 20; there are 75 scales in a lateral series, 14 between the lateral line and the origin of dorsal, and 45 between the lateral line and the origin of anal.

The body ovoid, deep, much compressed, its depth contained 1.7 times in length, the anterior dorsal profile a low, even curve from below nostrils to origin of dorsal; the head a little shorter than deep, 3.2 times in length of body; the depth of the short, strongly compressed caudal peduncle 7.1 times in length of body. The large, circular eye contained 2.8 times in length of head and placed high up near dorsal profile of head, leaving an almost flat, rather narrow interorbital space which is 3.8 times in head; the blunt snout slightly longer than eye diameter, 2.6 in length of head; the maxillary rather short and contained 3.3 times in head; mouth small, slightly oblique, with the lower jaw a little in advance of the upper and with the maxillary partly slipping into a groove under the widest portion of preorbital, which is finely serrated in front and more than half the diameter of orbit; the nostrils small and close together, the first one provided with a narrow marginal flap in front and with a much wider one behind; the preopercle is finely and evenly denticulated behind, and has at its angle a short, curved and slightly pointed spine reaching to gill opening; in front of this spine along inferior edge of interopercle are several small sharp teeth; both opercle and subopercle entire.

The scales generally small, those on head and fins very small to minute; accessory scales absent; the dorsal spines are rather slender and increase in height posteriorly, the last one slightly higher than third anal spine; both the rayed dorsal and anal broadly rounded; the caudal fin strongly convex; the pectoral ends behind above anus while the ventral extends to base of anterior anal rays, its outer ray filamentous and its spine contained 3 times in depth of body.

In alcohol the ground color is blackish brown, with five wide, curved, transverse white bands, alternating with narrow bluish ones; the first wide one immediately behind eye, the second between middle dorsal spines and anus, the third and fourth between the soft vertical fins, and the fifth in front of caudal peduncle; a median white line extends longitudinally from nape to tip of snout; a white line across anterior portion of each eye, and another across angle of mouth; the caudal fin blackish brown, whitish posteriorly, with white cross streaks.

Here described from a single specimen, 57 millimeters long, from Palawan, the first recorded from the Philippines. In this species the transverse lines on body are more crescent-shaped and the scales fewer than in *Holacanthus nicobariensis*.

Elsewhere this handsome fish occurs throughout the East Indies and southeastward in Melanesia to the Bismarck Archipelago.

HOLACANTHUS MESOLEUCUS (Bloch). Plate 7, fig. 1.

Chætodon mesoleucus BLOCH, Ichtyologie 6 (1788) 88, pl. 216, fig. 2.
Holacanthus mesoleucus LACÉPÈDE, Hist. Nat. Poiss. 4 (1803) 528, 537; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 127; GÜNTHER, Cat. Fishes 2 (1860) 54.
Chætodon mesomelas GMELIN, Syst. Nat. ed. 13 (1788) 1263.
Chætodontoplus mesoleucus BLEEKER, Atlas Ichth. 9 (1878) pl. 369, fig. 5.

Dorsal XII (rarely XI), 16 to 18; anal III, 16 to 18; there are 85 to 92 scales in a lateral series, 15 to 17 between the lateral line and the origin of dorsal, and 37 to 41 between the lateral line and the origin of anal.

The body oval and compressed, its depth contained from 1.6 to 1.9 times in length, the ventral outline an even curve from lower jaw to base of caudal peduncle; the head as long as deep, 3.1 to 3.5 times in length of body, its dorsal profile almost straight to hind edge of upper jaw; the depth of caudal peduncle 6.5 to 7.1 times in length of body and a little less than twice its own length; the interorbital space strongly arched and contained from 3.1 to 3.6 times in length of head; the circular eye contained 2.6 to 3.5 times in head; the maxillary from 3.4 to 3.6 times in head, and shorter than the bluntly rounded snout which is contained from 2.5 to 3.5 times; the mouth small, nearly horizontal, with the lower jaw slightly in advance of the upper; the preorbital coarsely denticulated in front of its lower edge, its greatest width a little over two-thirds eye; the preopercle armed at its angle with a long, stout, and slightly curved spine, which reaches almost to base of pectoral; above and in front of this spine the preopercle is strongly denticulated; both subopercle and interopercle have several more or less hidden teeth, the opercle unarmed.

The scales on trunk generally small and in irregular series, those on head very small to minute; accessory scales present on anterior portion of body; the lateral line is conspicuous, running close to upper end of dorsal fin and top of tail, and terminates at base of caudal; a second, short, straight lateral line extends along middle on each side of caudal peduncle, ending anteriorly between posterior third of dorsal and anal rays; the fourth, fifth, and sixth dorsal spines are the highest; both the soft dorsal and anal subequal and very broadly rounded; the caudal broadly and evenly convex; the obtusely rounded pectoral does not quite extend to anus, while the strongly pointed ventral just touches it.

The color in life clear lemon yellow on head and abdomen, shading into deep violet-brown or blackish on rest of body; the sides marked with very many irregular, wavy, often broken, longitudinal clear blue lines; a broad, dark, violet-brown, ocular band descends from nape to breast where it meets its fellow; the lips deep violet-brown; the dark color and blue markings of side extend over dorsal and anal, except that the first dorsal spine or two are yellow; the pectorals, ventrals, and caudal clear lemon yellow, the color of the last named very sharply marked from that of body; the soft dorsal and anal each margined posteriorly with a blue line; the caudal narrowly margined posteriorly with whitish.

In alcohol the blue markings change to white or very pale and the yellow becomes white or nearly so; the violet is lost in the dark part of body, the color becoming more or less black or velvety blackish.

Here described from twelve specimens ranging in length from 81 to 125 millimeters, from the following localities:

Puerto Galera, Mindoro, 1.
Masbate, 2.
Gigantangan Island, Leyte Province, 2.
Estancia, Panay, 1.
Zamboanga, Mindanao, 1.
Bato Bato, Tawitawi Island, 2.
Jolo, 3.

Our smallest example, collected in July, 1922, is a female about ready to spawn.

This beautiful little holacanthid, notable for the richness and delicacy of its quiet colors, is found only in the East Indies, from Singapore to the Moluccas, and is here reported for the first time from the Philippines. It is readily recognizable by its characteristic color markings, especially the wide, velvety, violet-brown ocular band, by the presence of 12 (rarely 11) dorsal spines, and by the scale counts.

HOLACANTHUS LEPIDOLEPIS Bleeker. Plate 23, fig. 1.

Holacanthus lepidolepis BLEEKER, Nat. Tijd. Ned. Ind. 4 (1853) 468; GÜNTHER, Cat. Fishes 2 (1860) 47; BLEEKER, Atlas Ichthy. 9 (1878) 67, pl. 372, fig. 1.

Holacanthus ignatius PLAYFAIR, Proc. Zool. Soc. London (1867) 852, pl. 41.

Dorsal XIV, 21; anal III, 20; there are 80 scales in a lateral series, 15 between the lateral line and the origin of dorsal, and 40 between the lateral line and the origin of anal.

The body ovoid, deep, compressed, the upper profile of head almost straight to below nostrils; the depth of body contained 1.7 times in length; the head a little shorter than deep, 2.6 in length of trunk; the caudal peduncle very deep and much compressed, its depth more than twice its length or greater than half the length of head; the evenly convex, rather wide interorbital is contained 3.3 times in length of head and equals length of maxillary; the circular eye is 4.7 times in head and 2.2 times in the bluntly rounded snout, which is contained 2.1 times in head; the gape of the small mouth almost horizontal, the jaws equal; the upper one slips partly under preorbital, which has in front at its widest portion a few small strong teeth; the nostrils close together on the depressed portion of snout in front of eye, the first one almost a vertical slit, more than a third of eye diameter, placed about halfway between anterior margin of orbit and upper tip of premaxillary, and provided with a flap behind; the other nostril nearly circular, simple, placed above and behind first nostril; the preopercle is finely serrated behind and coarsely serrated below, and has at its angle a long, stout, slightly curved spine, which is about as long as snout.

The head and fins covered densely with small to minute scales; accessory scales present all over body; the lateral line is conspicuous and extends behind to base of caudal fin; the dorsal spines evenly graduated to the last, which is the longest and nearly equals length of snout and eye together; the anterior dorsal and anal rays produced into filaments, which extend beyond the posterior margin of the strongly convex caudal; the pectoral longest superiorly, slightly pointed, nearly equal to length of head, its posterior end a little before anus; the ventral fin is longer than the pectoral and extends to origin of anal, its outer ray filamentous, its spine 1.6 in head or twice the length of maxillary.

In alcohol the ground color is olive brown, darker anteriorly and posteriorly; the scales of sides have each a blackish spot, dark blue in life, forming diagonal rows; the soft dorsal, anal, caudal peduncle, and caudal thickly sprinkled with small pearly white or pearl blue spots which extend forward upon posterior third of trunk; the dorsal and anal narrowly margined with bluish white, their produced portions yellowish; the caudal fin tipped with bluish white; there are longitudinal bluish lines on the membranes of ventral.

Here described from an example, 290 millimeters long, taken at Ambil Island, Mindoro. This is the first Philippine record of the species, which is known elsewhere only from the sea of Batavia.

The senior author saw a very large specimen of this species off the wharf at Bato Bato, Tawitawi Island. It was 400 millimeters or more in length.

PLATACIDÆ

The rhomboid body much compressed laterally and greatly elevated, with a very short, blunt snout, the depth nearly equal to the length, or much more than the length in the young; the head much deeper than long, with very steep profile. One dorsal, with 3 to 7 spines more or less hidden, anal spines 3; ventrals long to very long. Scales ctenoid, moderate to small, extending upon dorsal, anal, and caudal. Mouth small, teeth setiform, trilobed; vomerine teeth present in some species; air bladder simple; branchiostegals 6.

But one genus known, occurring in the Indian Ocean and the East Indies, north to Southern Japan.

Genus PLATAX Cuvier

Platax CUVIER, Régne Anim. 2 (1817) 334.

The generic characters are included above. Of the many species named by authors perhaps four are valid, of which but one has thus far been taken in the Philippines.

PLATAX ORBICULARIS (Forskål). Plate 24.

Chætodon orbicularis FORSKÅL, Descrip. Anim. (1775) 59.

Platax orbicularis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 174; RÜPPELL, Atlas Fische des Rothen Meeres (1828) 67, pl. 18, fig. 3; GÜNTHER, Cat. Fishes 2 (1860) 490; Fische der Südsee 1 (1873) 140; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1905) 246; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 335; Bull. Bur. Fisheries 26 (1907) 32; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1907) 97; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 268.

Chætodon vespertilio BLOCH, Ichtyologie 6 (1788) 49, pl. 199, fig. 2 (very poor figure); BENNETT, Fishes of Ceylon (1834) 5, pl. 5 (fine figure).

Platax vespertilio CUVIER, Règne Anim. ed. 1 2 (1817) 334; GÜNTHER, Cat. Fishes 2 (1860) 489; DAY, Fishes of India (1878) 236, pl. 51A, fig. 5; BLEEKER, Atlas Ichth. 9 (1878) 74, pl. 379, fig. 1, and pl. 380, figs. 2 and 3; MEYER, Ann., Soc. España Hist. Nat. 14 (1885) 25.

Platax vespertilio japonicus SCHLEGEL, Pisces, Fauna Japonica, pl. 43.

Chætodon teira FORSKÅL, Descrip. Anim. (1775) 60; BLOCH, Ichtyologie 6 (1788) 47, pl. 199, fig. 1 (fine figure).

Platax teira CUVIER, Règne Anim. ed. 1 2 (1817) 334; GÜNTHER, Cat. Fishes 2 (1860) 492; Fische der Südsee 1 (1873) 141; DAY, Fishes of India (1878) 235, pl. 51B, fig. 4; BLEEKER, Atlas Ichth. 9 (1878) 73, pl. 379, fig. 2, and pl. 382, fig. 1; JORDAN and FOWLER, Proc. U. S. Nat. Mus. 25 (1902) 526; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 335; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 (1922) 55.

Common names.—English, leaf fish, bat fish; Tagalog, *dahon gabi;* Leyte-Visayan, *dayapugan;* Ilongo-Visayan, *talocogan.*

We include here all the synonymy of the numerous nominal species listed by Bleeker under both *Platax teira* and *Platax vespertilio.* Some of these were founded on young specimens, others on individual variations.

Dorsal V, 32 to 39; anal III, 23 to 28; there are 47 to 68 scales in a horizontal series from the angle of the gill opening to the base of caudal, 22 to 35 between the lateral line and the origin of dorsal, and 39 to 57 between the lateral line and the origin of anal.

The body very deep and much compressed, very strongly arched above and below, the dorsal profile more convex than the ventral and markedly obtuse from snout to origin of dorsal fin; in the adult the greatest depth of body nearly equal to its length, and in very young examples much greater; the head much deeper than long, its upper profile much more elevated and very steep, its length 2.8 to 3.2 times in length of body; the depth of the short, strongly compressed caudal peduncle contained from 6.1 to 7.1 times in length of body; the interorbital space very broad and very strongly convex, its width 2.1 to 3 times in head and greater than length of maxillary, which is contained from 2.7 to 3.6 times; the large, circular eye superior and slightly anterior, but in very large individuals about midway in length of head, its diameter 3 to 4.3 times in that of head; the bluntly rounded snout obtuse and 1.9 to 2.6 times in head, or nearly twice width of preorbital which is contained from 3.3 to 5.6 times in head; the mouth small and horizontal, the jaws even, the slender and compressed teeth setiform and trilobed at their summits, none present on vomer; the two nostrils far apart, the anterior nostril small, circular, and having a low fleshy rim, the posterior one a nearly vertical elongate opening directly in front of orbit; the orbital ring and the opercular margin entire.

The scales ctenoid and of small size, becoming numerous and very small to minute on head, vertical fins, and caudal; the lateral line is slightly arched and terminates at base of caudal fin; the dorsal spines more or less hidden and evenly graduated to the last, which is the highest and joined to the soft dorsal; the anal spines decrease also in height behind and are joined to soft anal; the dorsal and anal rays become lower posteriorly, the anterior ones becoming very much prolonged in the young and extending beyond end of caudal fin; the middle rays of caudal slightly prolonged, making the posterior end of fin concave on either half; the short, rather broad pectoral is contained from 1.1 to 1.7 times in head and does not extend beyond base of anal spines; the ventral rather long and very much produced in very young examples, sometimes reaching end of caudal fin, its spine 1.2 to 1.7 times in length of head or approximately as long as pectoral.

In life the general color is blackish brown, with a gloss of purplish; the young have three diffused blackish bands, the first one as wide as orbit and sometimes reticulated with black, running downward through eye to ventrals; the second broad band descends from dorsal spines and a few of the rays, passing behind head toward belly, where it is lost; a third, very broad band runs from posterior two-thirds of soft dorsal to the same part of soft anal; these blackish bands disappear with age; the fins black, with the exception of pectoral which is yellowish.

In adults the color between the bands may be grayish to brownish, often yellowish, with a silvery luster over all; the pectoral and ventrals yellow or golden, except basally, and the caudal sometimes yellow, except its posterior margin.

In alcohol the fish loses its purplish tint, and is dark brown or blackish brown, with the vertical bands very much diffused in the ground color.

Here described from thirty-six specimens of varying sizes in the Bureau of Science collection, the largest 275 millimeters in length. They were collected at the following places: Manila; Monja Island; Hamilo and Nasugbu, Batangas Province; San Miguel Bay and Cabusao, Camarines Sur; Calapan, Mindoro; Concepcion, Busuanga Island; Culion Island; Estancia and Dumangas, Panay; Guimaras Island; Dulag and Tacloban, Leyte; Inabanga, Bohol; Puerto Princesa, Palawan; Butuan and Agusan River, Agusan; Balabac Island; Caldera Bay, Zamboanga; and Tubigan, Jolo, Sibutu, and Sitankai Islands, Sulu Archipelago. We have examined also two examples, 72 and 76 millimeters long, from Sandakan, Borneo.

We have examined very many living, fresh, and alcoholic specimens, and the senior author has kept living adult and juvenile specimens under observation for six years. As a result of our studies we are unable to distinguish more than one species. It is a very easy matter to select a series of typical *P. orbicularis* and *P. teira* of authors, but we find every possible sort of gradation between. The large-scaled forms seem very distinct, but careful examination of many specimens shows that small accessory scales are intercalated, and as these become more numerous the smaller-scaled "species" is formed. We have found every stage showing the transition from large-scaled to small-scaled forms.

The young undergo great changes in body shape, color, and relative size and shape of the fins. Young specimens, after having been kept under continuous observation for several years, seemed literally transformed during that time. In some cases it did not seem possible that they could be our common species, but in time they altered until they were like the typical adults. We do not consider differences in the shape of the profile of any specific value.

The leaf fish does well in captivity, a considerable number having been kept in the Bureau of Science aquarium for ten years; unfortunately, during our absence from Manila in 1924 they were neglected, and all died but one, which is still alive, twelve years after having been placed in the tank. It reaches a large size, and in favorable localities, such as rocky reefs or small sheltered bays, may be quite abundant. The senior author has seen them caught in considerable numbers with hook and line, using banana for bait and fishing at a depth of 18 to 20 meters. Some of them were about 500 millimeters in diameter, with a weight of 3 to 4 kilograms, and were entirely too large to be preserved in any available container. The flesh is of excellent quality. They are caught in bobos and by hook and line.

Under the names *Platax orbicularis, Platax vespertilio, Platax teira,* and *Platax* sp. this fish has been recorded from the following Philippine localities: "Philippine Islands," by Günther; Cebu, by Meyer; Iloilo by Jordan and Seale; Ticao and Cagayancillo by Jordan and Richardson; Zamboanga by Seale and Bean and by Fowler and Bean; and from Jolo by Evermann and Seale.

The leaf fish is widely distributed, and ranges from the Red Sea and east coast of Africa to Samoa and the Society Islands, its center of distribution apparently in the East Indies; it extends northward to China, Formosa, northern Japan, and the Bonin Islands; southward it ranges to the northwestern coast of Australia.

In order to show the scale variations we append the counts made on twenty-five specimens.

Scales above lateral line to origin of dorsal.	Scales in horizontal series from angle of gill opening to caudal base.	Scales below lateral line to origin of anal.
22	50	41
23	47	46
24	50	40
24	52	47
25	48	47
25	55	46
26	47	43
26	49	41
26	50	39
26	51	46
27	47	41
28	55	45
29	50	41
29	63	53
30	52	48
30	65	54
30	67	52
31	57	50
31	60	48
33	58	55
33	60	50
33	64	57
33	68	55
34	64	55
35	62	50

RECAPITULATION

Family 1. DREPANIDÆ

Genus 1. DREPANE Cuvier and Valenciennes

1. *Drepane punctata* (Linnæus).
2. *Drepane longimana* (Bloch and Schneider).

Family 2. SCATOPHAGIDÆ

Genus 2. SCATOPHAGUS Cuvier and Valenciennes

3. *Scatophagus argus* (Boddaert).

Family 3. EPHIPPIDÆ

Genus 3. EPHIPPUS Cuvier

4. *Ephippus orbis* (Bloch).

Family 4. CHÆTODONTIDÆ

Genus 4. CHELMON Cuvier

5. *Chelmon rostratus* (Linnæus).

Genus 5. FORCIPIGER Jordan and McGregor

6. *Forcipiger longirostris* (Broussonet).

Genus 6. PARACHÆTODON Bleeker

7. *Parachætodon ocellatus* Cuvier and Valenciennes.

Genus 7. CHÆTODON Linnæus

8. *Chætodon (Megaprotodon) strigangulus* (Solander).
9. *Chætodon (Gonochætodon) triangulum* (Kuhl and Van Hasselt).
10. *Chætodon plebeius* Broussonet.
11. *Chætodon auriga* Forskål.
12. *Chætodon vagabundus* Linnæus.
13. *Chætodon argentatus* Smith and Radcliffe.
14. *Chætodon chrysurus* Desjardins.
15. *Chætodon rafflesi* Bennett.
16. *Chætodon modestus* (Schlegel).
17. *Chætodon octofasciatus* Bloch.
18. *Chætodon collare* Bloch.
19. *Chætodon ornatissimus* (Solander).
20. *Chætodon melanotus* Bloch and Schneider.
21. *Chætodon ulietensis* Cuvier and Valenciennes.
22. *Chætodon lineolatus* Quoy and Gaimard.
23. *Chætodon bella-maris* Seale.
24. *Chætodon adiergastos* Seale.
25. *Chætodon fasciatus* Forskål.
26. *Chætodon selene* Bleeker.

27. *Chætodon carens* Seale.
28. *Chætodon ephippium* Cuvier and Valenciennes.
29. *Chætodon kleini* Bloch.
30. *Chætodon punctato-fasciatus* Cuvier and Valenciennes.
31. *Chætodon unimaculatus* Bloch.
32. *Chætodon trifasciatus* Mungo Park.
33. *Chætodon bennetti* Cuvier and Valenciennes.
34. *Chætodon speculum* Kuhl and Van Hasselt.
35. *Chætodon citrinellus* Broussonet.

Genus 8. CORADION Kaup

36. *Coradion chrysozonus* (Kuhl and Van Hasselt).

Genus 9. MICROCANTHUS Swainson

37. *Microcanthus strigatus* (Cuvier and Valenciennes).

Genus 10. HEMITAURICHTHYS Bleeker

38. *Hemitaurichthys polylepis* Bleeker.

Genus 11. HENIOCHUS Cuvier

39. *Heniochus acuminatus* Linnæus.
40. *Heniochus singularius* Smith and Radcliffe.
41. *Heniochus varius* (Cuvier and Valenciennes).
42. *Heniochus permutatus* Bennett.

Genus 12. HOLACANTHUS Lacépède

43. *Holacanthus lamarcki* Lacépède.
44. *Holacanthus sexstriatus* (Kuhl and Van Hasselt).
45. *Holacanthus multifasciatus* Smith and Radcliffe.
46. *Holacanthus diacanthus* (Boddaert).
47. *Holacanthus tibicen* (Cuvier and Valenciennes).
48. *Holacanthus bicolor* (Bloch).
49. *Holacanthus vroliki* Bleeker.
50. *Holacanthus trimaculatus* Lacépède.
51. *Holacanthus xanthometopon* Bleeker.
52. *Holacanthus imperator* (Bloch).
53. *Holacanthus nicobariensis* (Bloch and Schneider).
54. *Holacanthus semicirculatus* Cuvier and Valenciennes.
55. *Holacanthus mesoleucus* (Bloch).
56. *Holacanthus lepidolepis* Bleeker.

Family 5. PLATACIDÆ

Genus 13. PLATAX Cuvier

57. *Platax orbicularis* (Forskål).

ILLUSTRATIONS

PLATE 1

FIG. 1. *Drepane punctata* (Linnæus). (Drawing by P. Bravo.)
2. *Drepane longimana* (Bloch and Schneider). (Drawing by P. Bravo.)

PLATE 2

FIG. 1. *Ephippus orbis* (Bloch). (Drawing by P. Bravo.)
2. *Scatophagus argus* (Boddaert). (Drawing by P. Bravo.)

PLATE 3

FIG. 1. *Chelmon rostratus* (Linnæus). (Drawing by P. Bravo.)
2. *Forcipiger longirostris* (Broussonet). (Drawing by A. L. Canlas.)

PLATE 4

FIG. 1. *Chætodon strigangulus* (Solander). (Drawing by P. Bravo.)
2. *Chætodon argentatus* Smith and Radcliffe. (After Smith and Radcliffe.)

PLATE 5

FIG. 1. *Chætodon triangulum* (Kuhl and Van Hasselt). (Drawing by A. L. Canlas.)
2. *Chætodon vagabundus* Linnæus. (Drawing by A. L. Canlas.)

PLATE 6

FIG. 1. *Chætodon plebeius* Broussonet. (Drawing by A. L. Canlas.)
2. *Chætodon rafflesi* Bennett. (Drawing by A. L. Canlas.)

PLATE 7

FIG. 1. *Holacanthus mesoleucus* (Bloch). (Drawing by A. L. Canlas.)
2. *Chætodon auriga* Forskål. (Drawing by J. N. Nievera.)

PLATE 8

FIG. 1. *Chætodon chrysurus* Desjardins. (Drawing by J. N. Nievera.)
2. *Chætodon bennetti* Cuvier and Valenciennes. (Drawing by A. L. Canlas.)

PLATE 9

FIG. 1. *Chætodon ornatissimus* (Solander). (Drawing by A. L. Canlas.)
2. *Chætodon fasciatus* Forskål. (Drawing by A. L. Canlas.)

PLATE 10

FIG. 1. *Chætodon selene* Bleeker. (Drawing by A. L. Canlas.)
2. *Chætodon lineolatus* Quoy and Gaimard. (Drawing by J. N. Nievera.)

PLATE 11

FIG. 1. *Chætodon unimaculatus* Bloch. (Drawing by P. Bravo.)
2. *Chætodon melanotus* Bloch and Schneider. (Drawing by A. L. Canlas.)

PLATE 12

FIG. 1. *Chætodon punctato-fasciatus* Cuvier and Valenciennes. (Drawing by M. L. Nievera.)
2. *Scatophagus argus* (Boddaert), young. (Drawing by A. L. Canlas.)

PLATE 13

FIG. 1. *Chætodon trifasciatus* Mungo Park. (Drawing by A. L. Canlas.)
2. *Chætodon kleini* Bloch. (Drawing by A. L. Canlas.)

PLATE 14

FIG. 1. *Chætodon citrinellus* Broussonet. (Drawing by A. L. Canlas.)
2. *Chætodon speculum* Kuhl and Van Hasselt. (Drawing by A. L. Canlas.)

PLATE 15

FIG. 1. *Chætodon adiergastos* Seale. (After Seale.)
2. *Chætodon carens* Seale. (After Seale.)

PLATE 16

Holacanthus lamarcki Lacépède. (Drawing by A. L. Canlas.)

PLATE 17

FIG. 1. *Chætodon bella-maris* Seale. (After Seale.)
2. *Holacanthus multifasciatus* Smith and Radcliffe. (After Smith and Radcliffe.)

PLATE 18

FIG. 1. *Microcanthus strigatus* (Cuvier and Valenciennes). (Drawing by P. Bravo.)
2. *Heniochus singularius* Smith and Radcliffe. (After Smith and Radcliffe.)

PLATE 19

FIG. 1. *Holacanthus semicirculatus* Cuvier and Valenciennes. (Drawing by A. L. Canlas.)
2. *Heniochus acuminatus* Linnæus. (Drawing by P. Bravo.)

PLATE 20

FIG. 1. *Holacanthus tibicen* (Cuvier and Valenciennes). (Drawing by J. N. Nievera.)
2. *Heniochus varius* Cuvier and Valenciennes. (Drawing by P. Bravo.)

PLATE 21

FIG. 1. *Holacanthus trimaculatus* Lacépède. (Drawing by M. L. Nievera.)
2. *Holacanthus diacanthus* (Boddaert). (Drawing by A. L. Canlas.)

PLATE 22

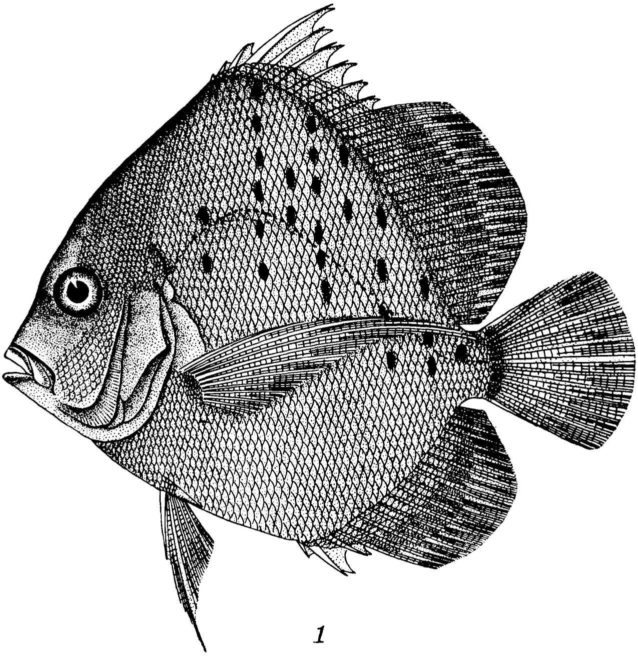
FIG. 1. *Holacanthus vroliki* Bleeker. (Drawing by J. N. Nievera.)
2. *Heniochus permutatus* Bennett. (Drawing by A. L. Canlas.)

PLATE 23

FIG. 1. *Holacanthus lepidolepis* Bleeker. (Drawing by A. L. Canlas.)
2. *Holacanthus imperator* (Bloch). (Drawing by A. L. Canlas.)

PLATE 24

Platax orbicularis Forskål. (Drawing by A. L. Canlas.)



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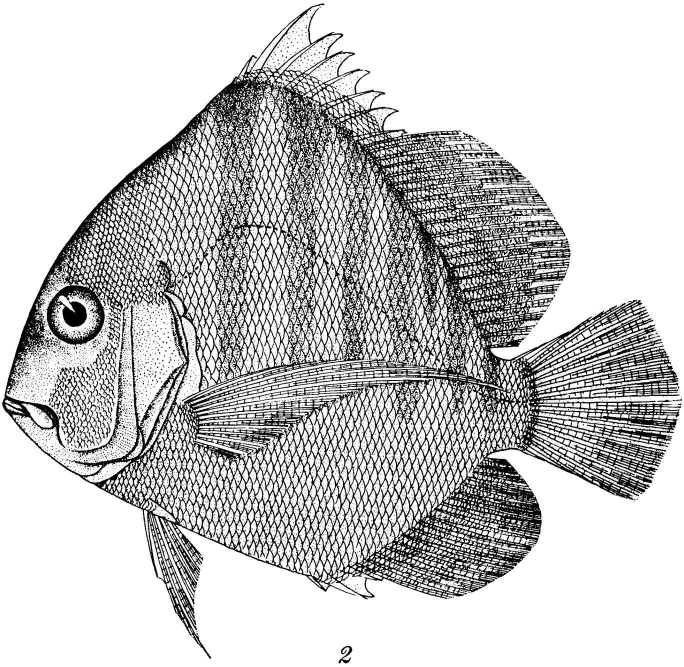

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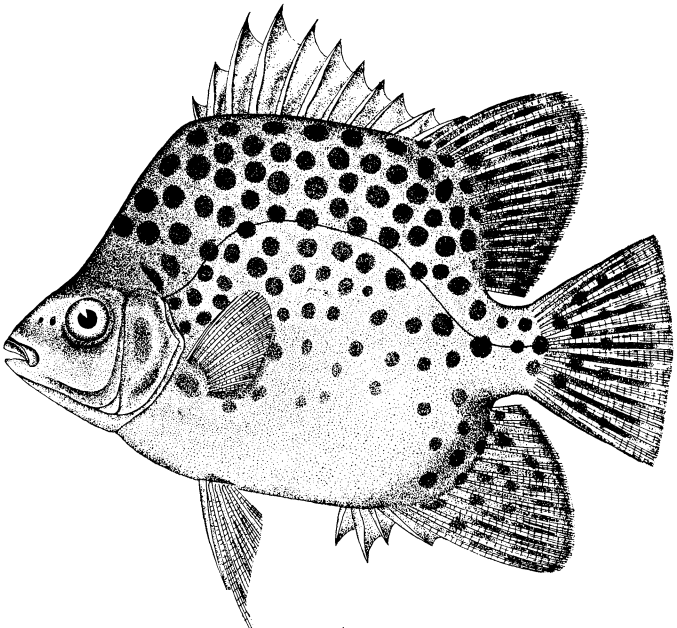

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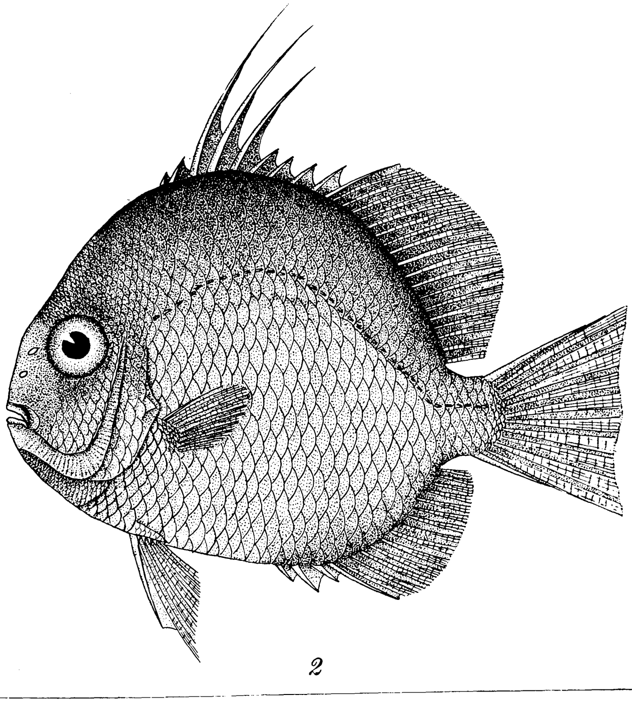

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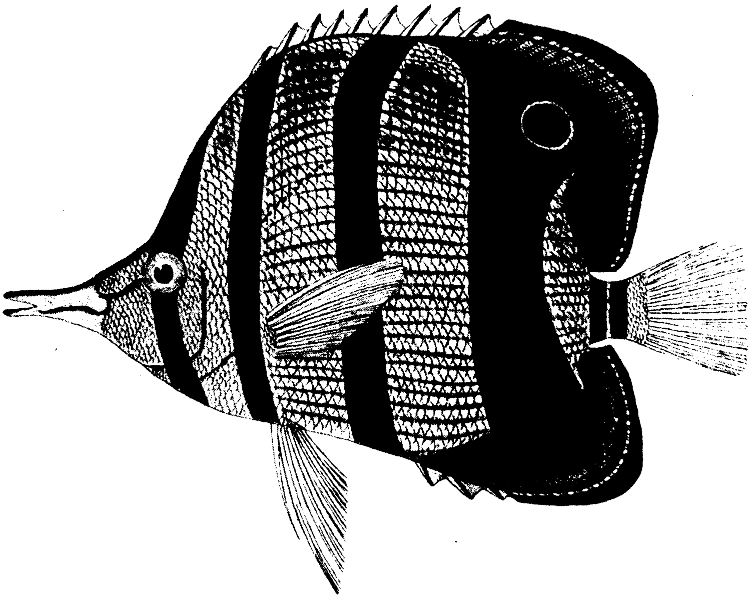

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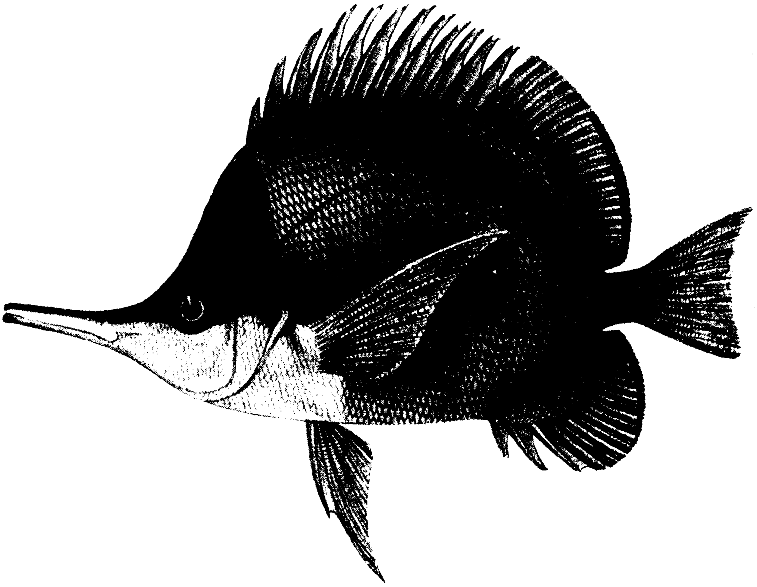

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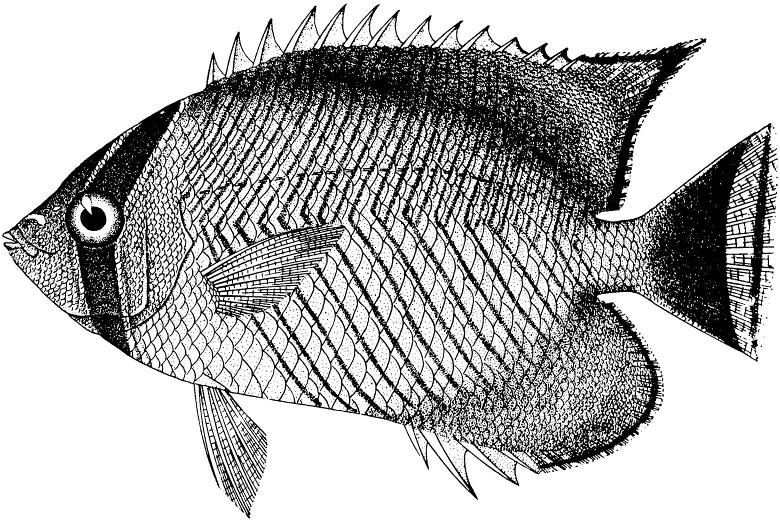

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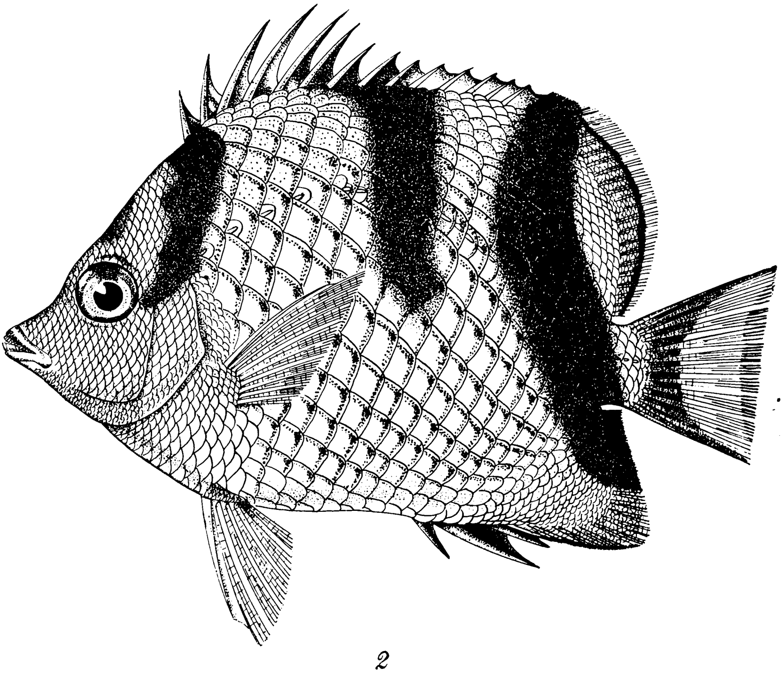

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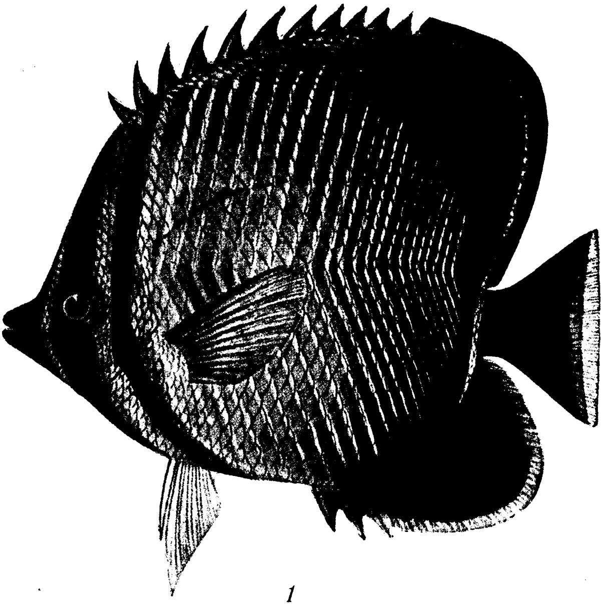

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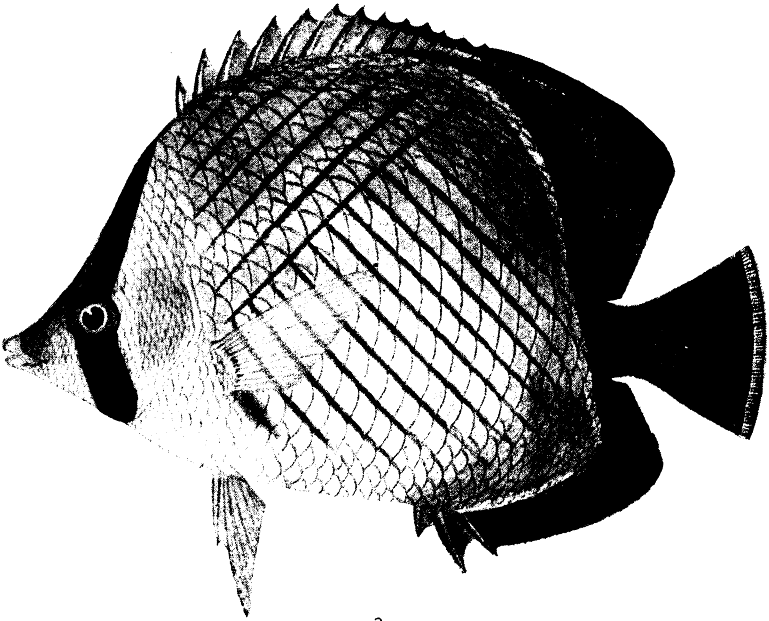

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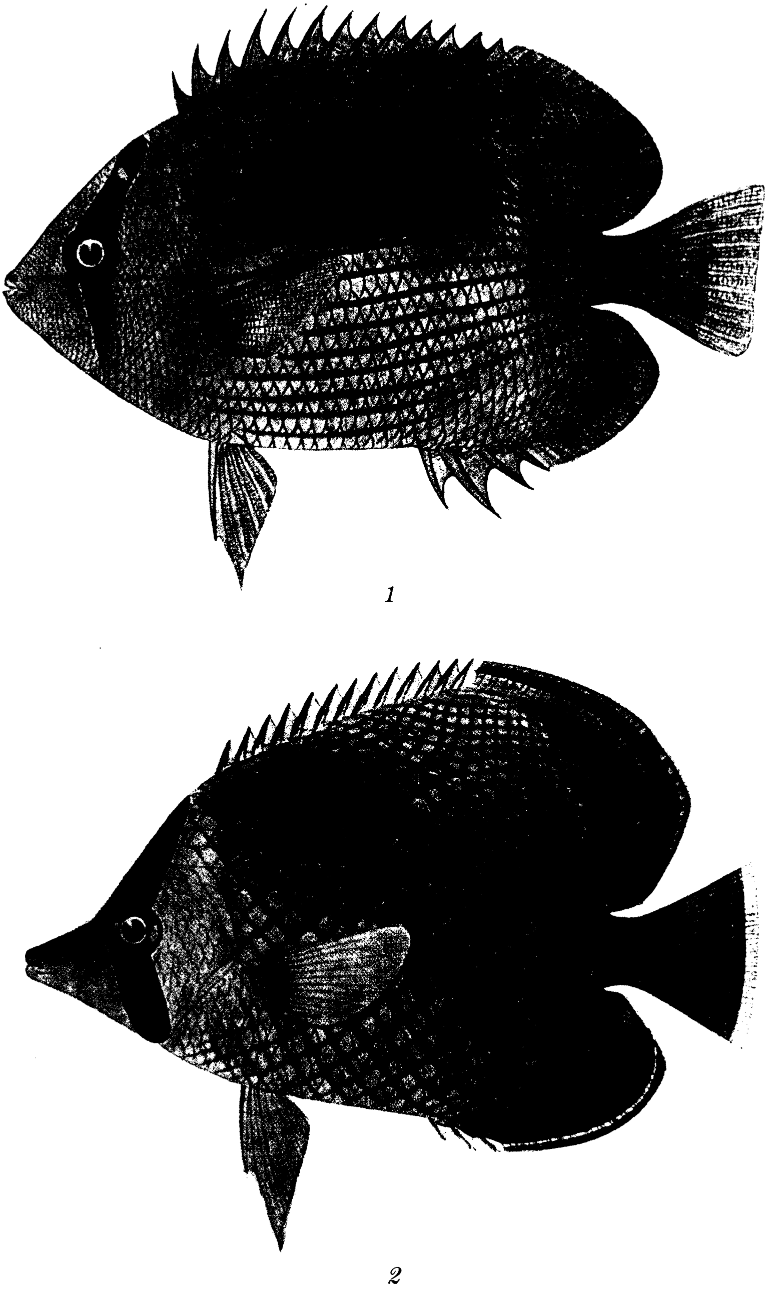

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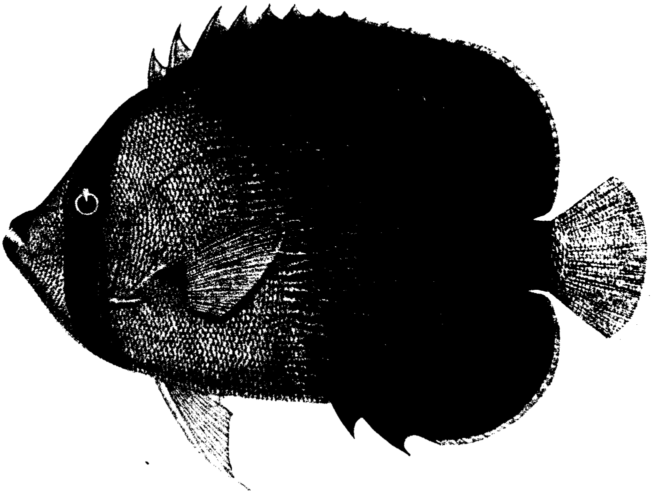

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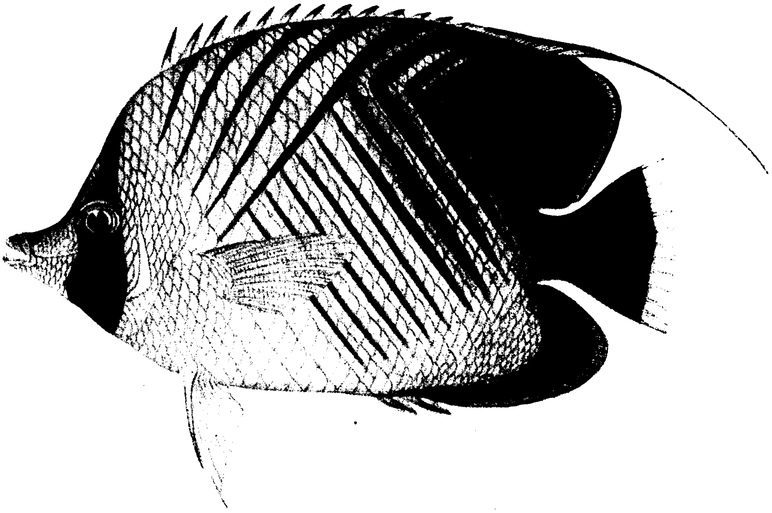

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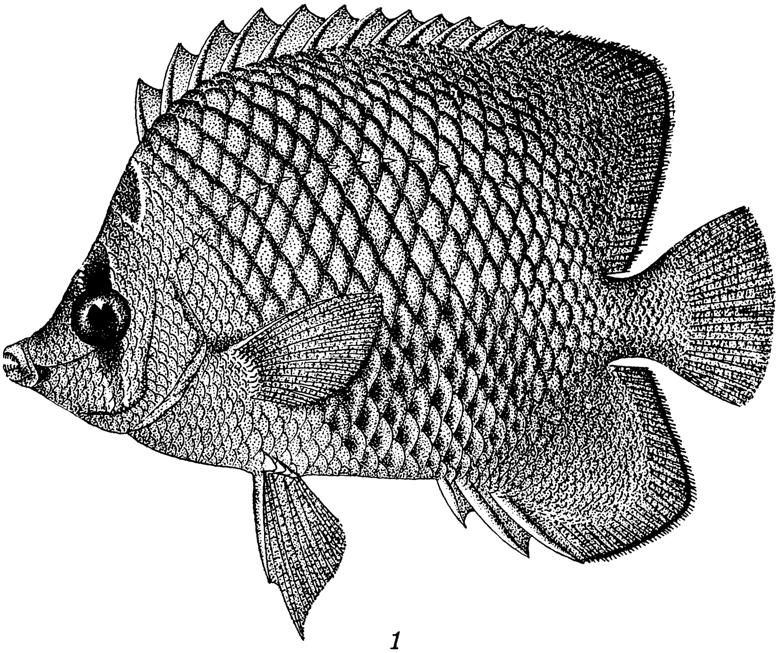

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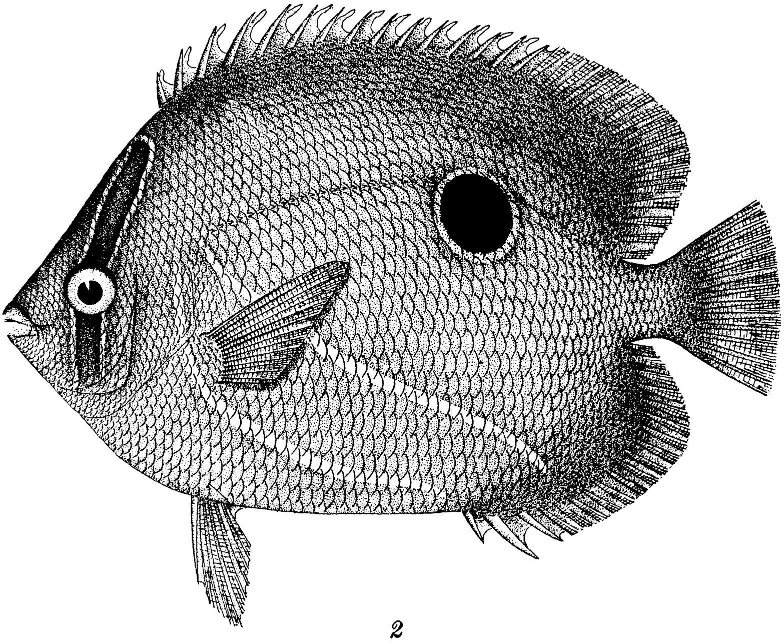

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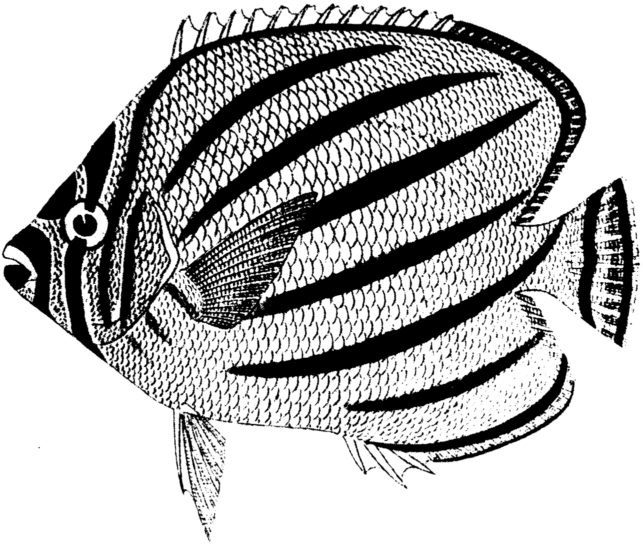

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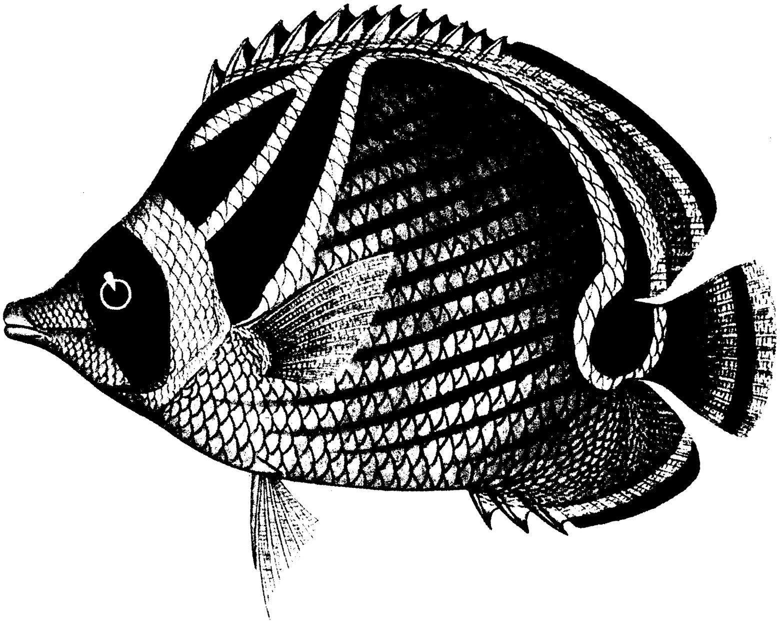

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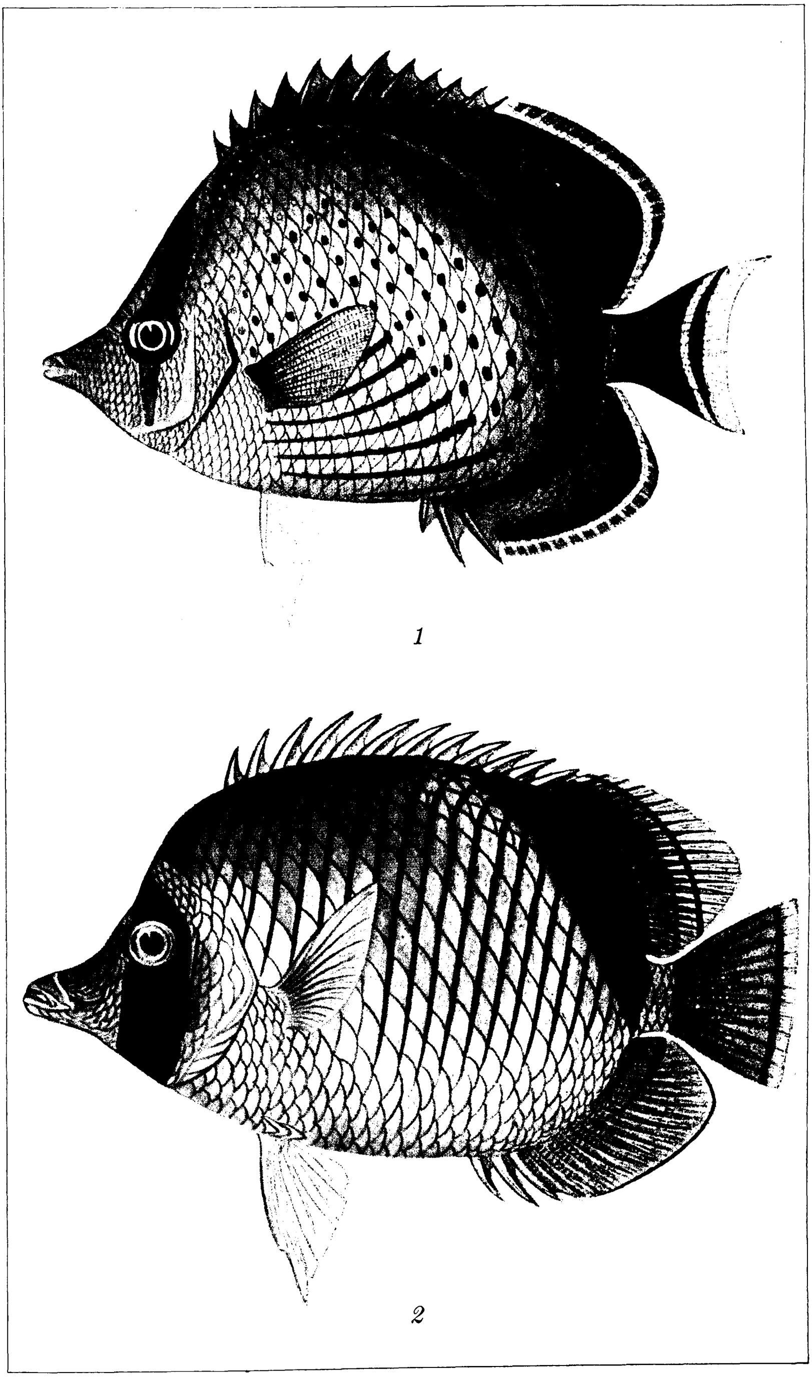

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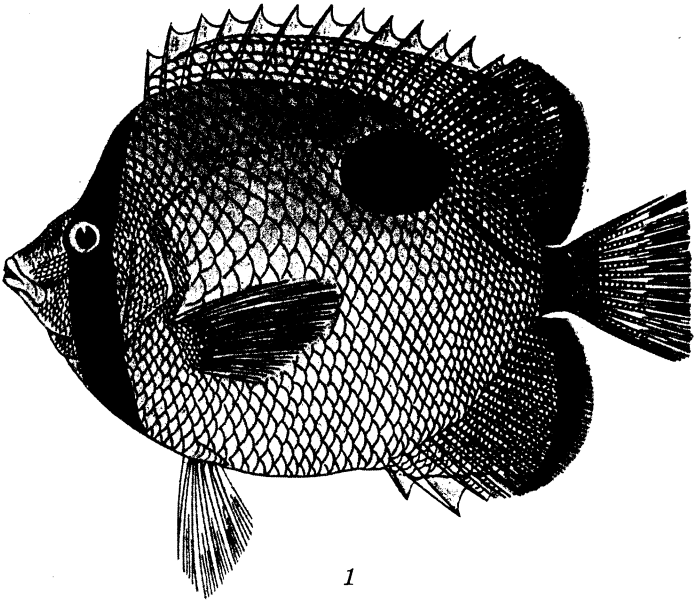

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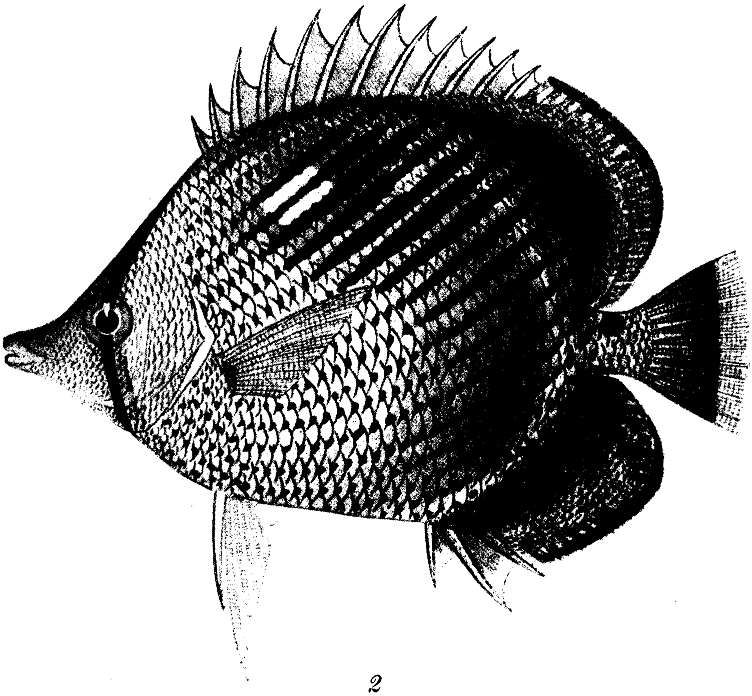

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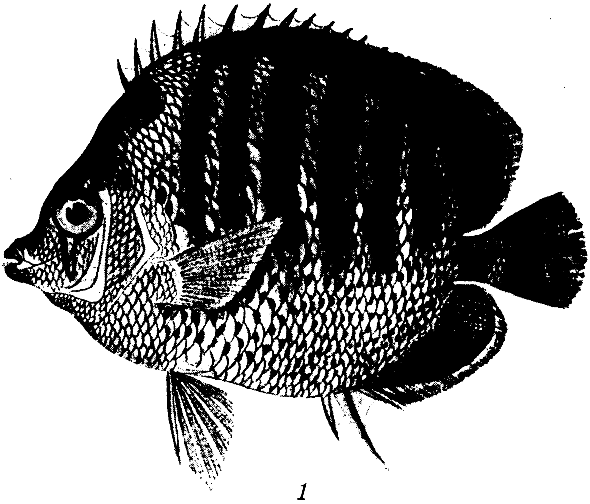

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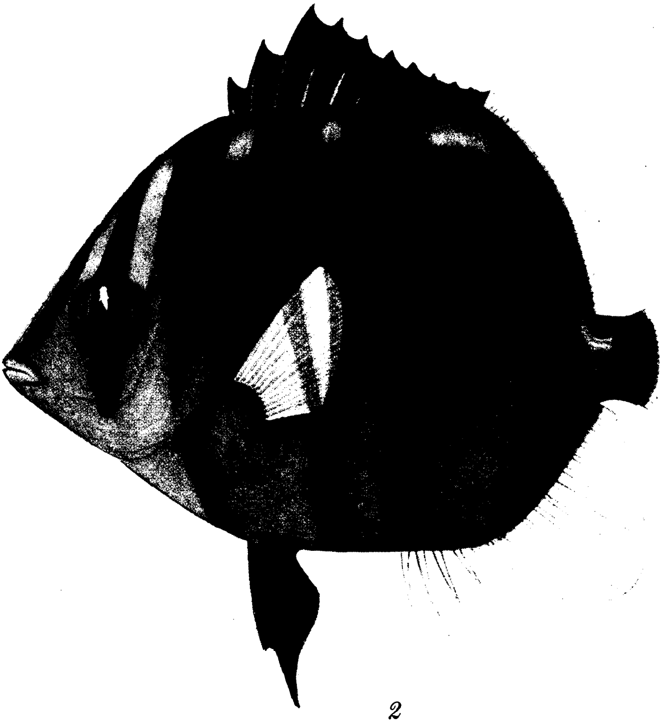

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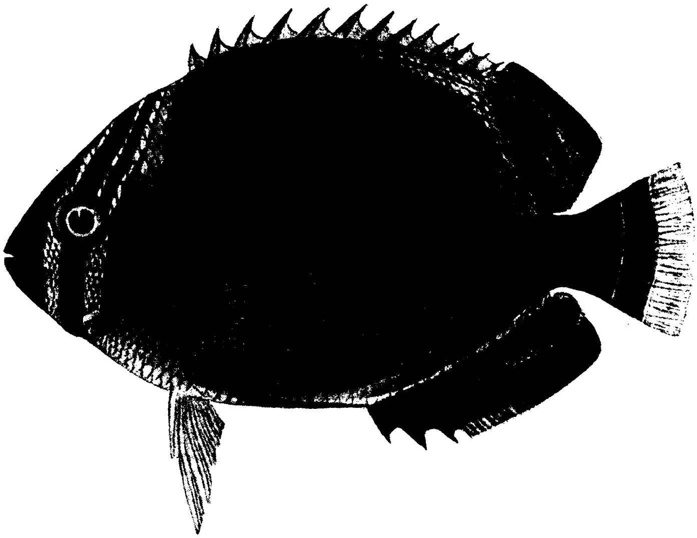

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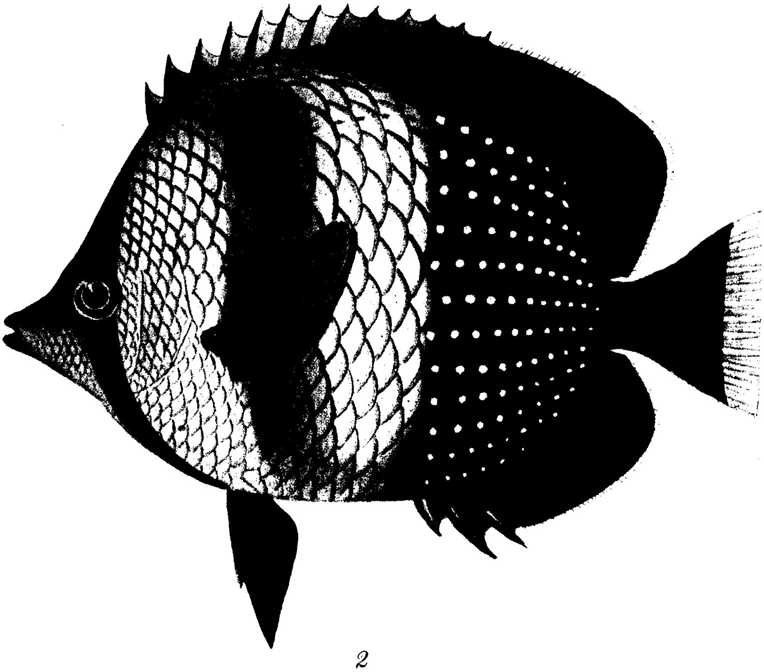

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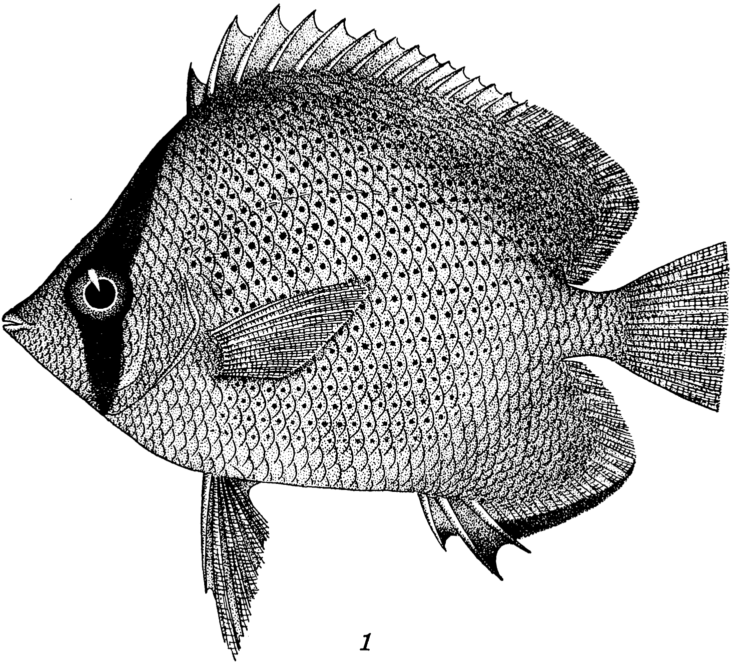

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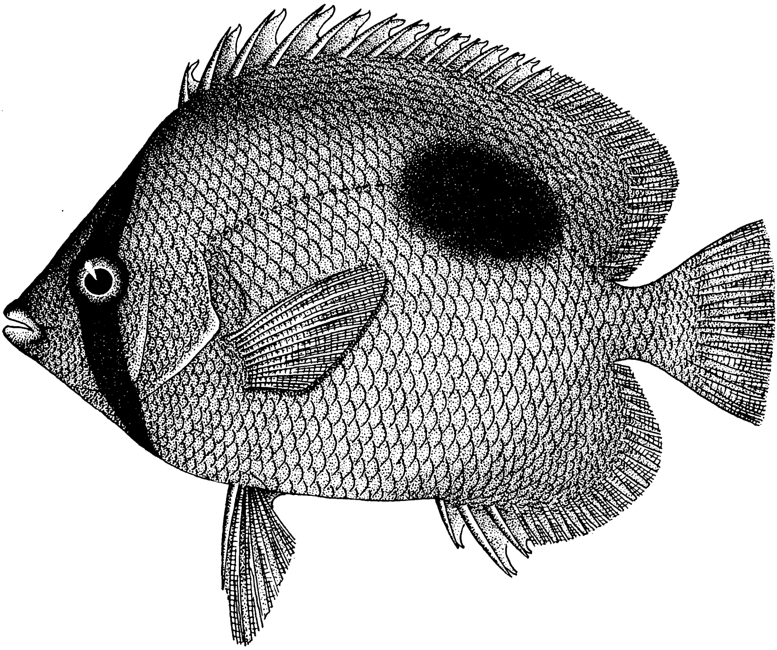

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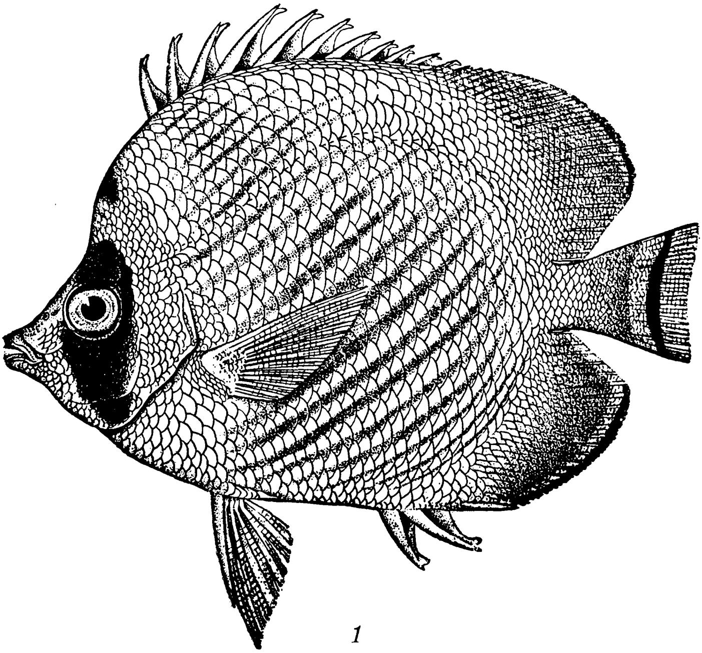

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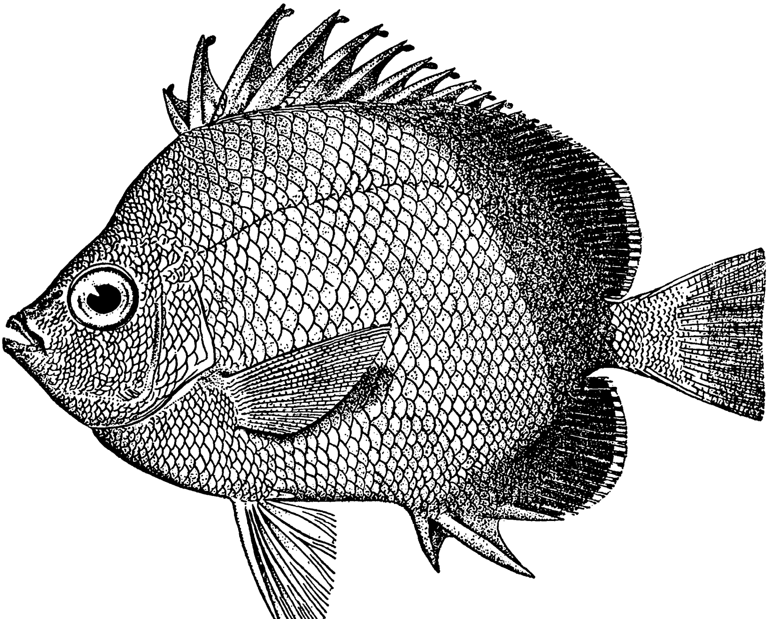

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PLATE 15.

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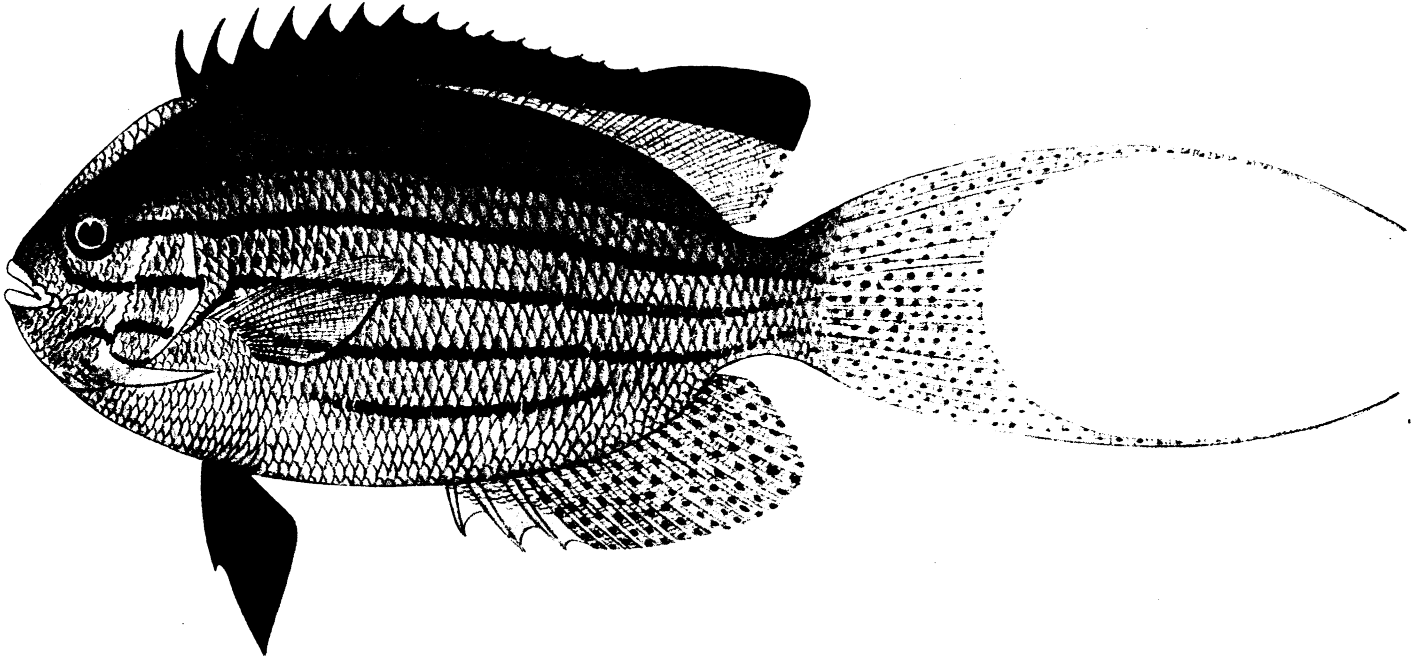

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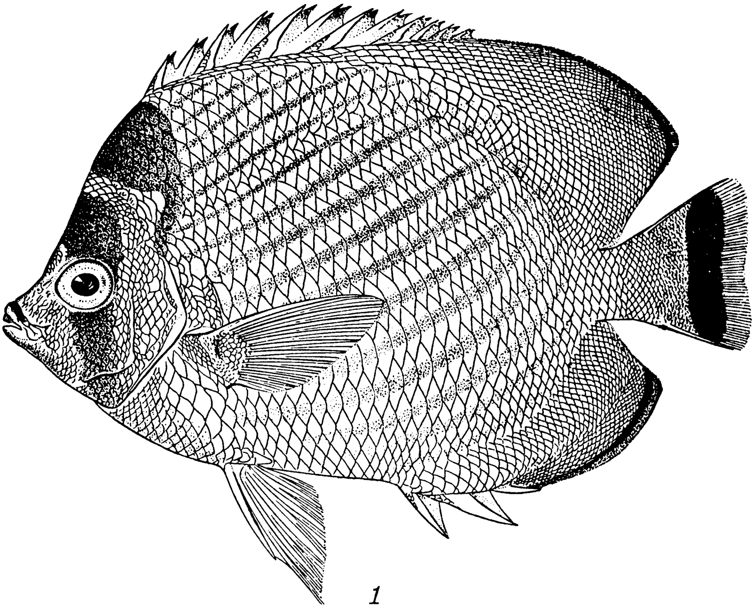

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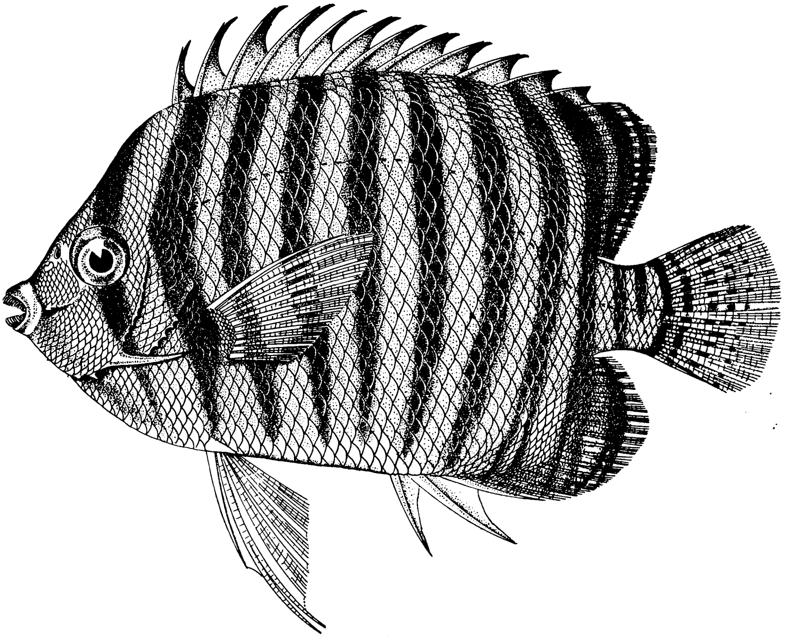

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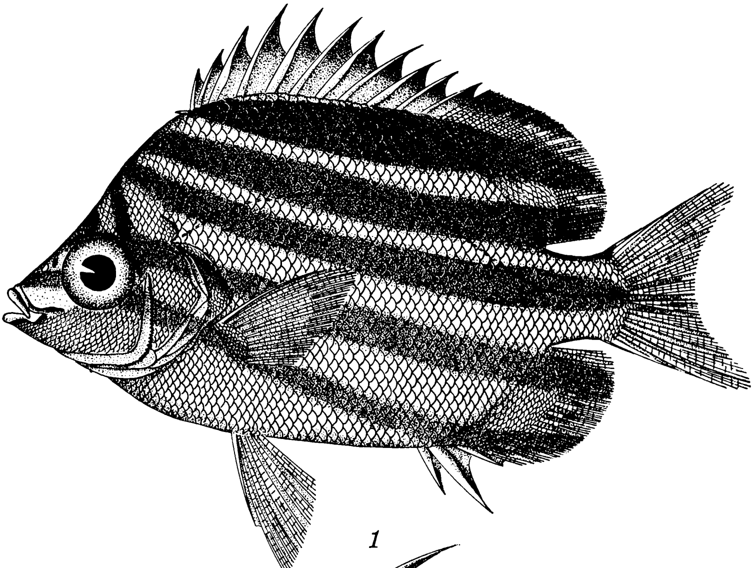

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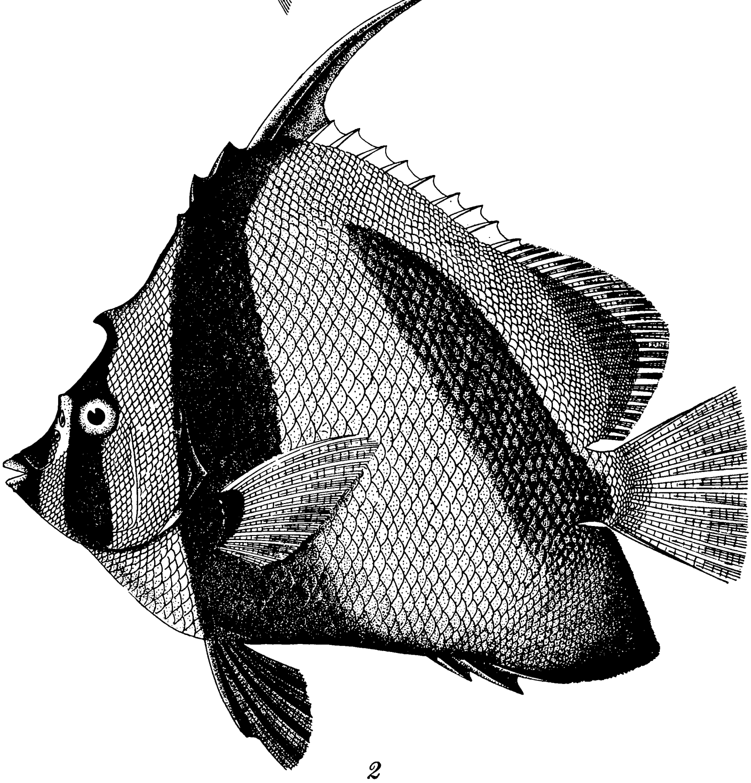

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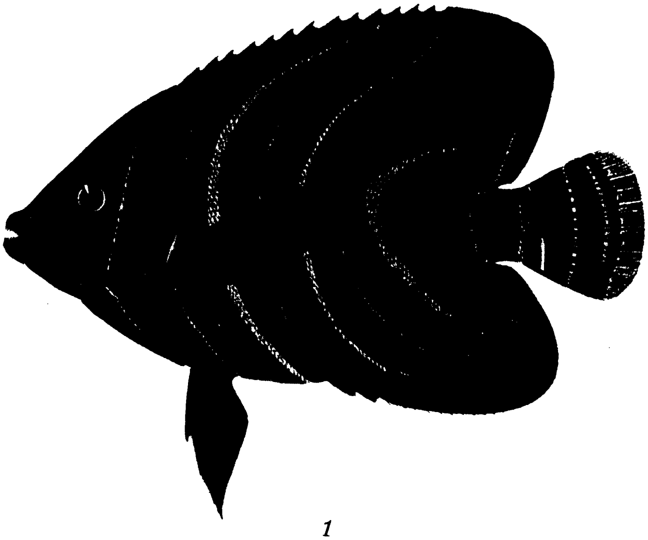

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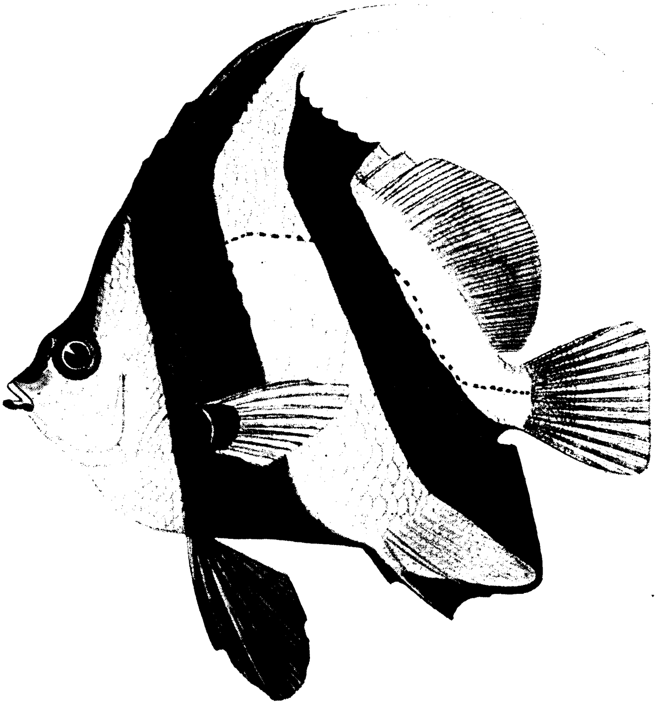

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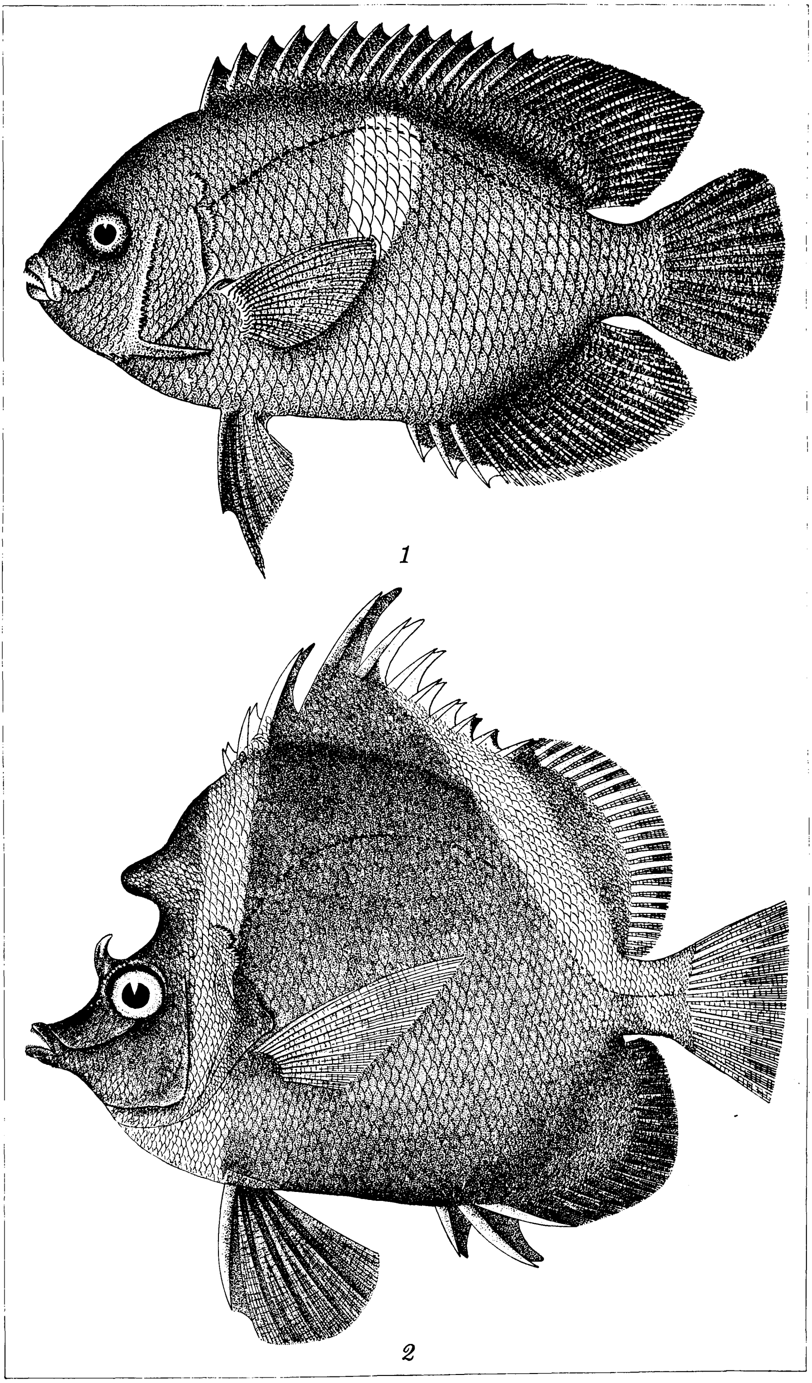

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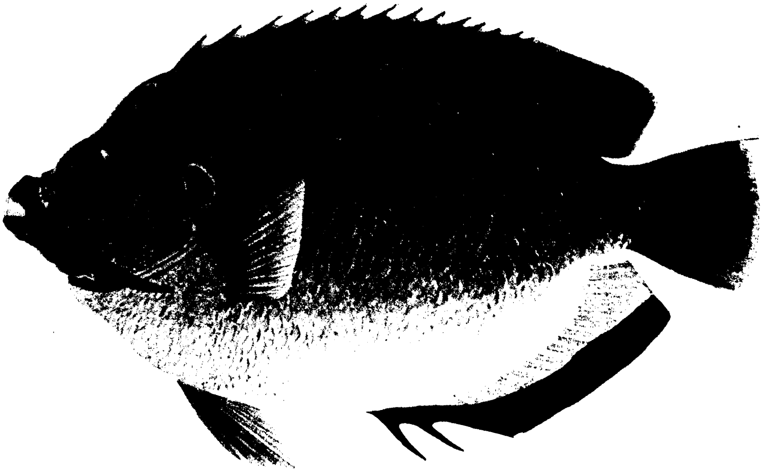

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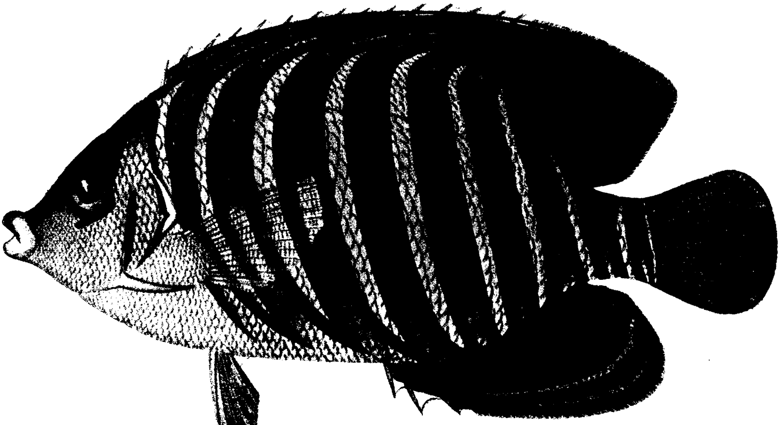

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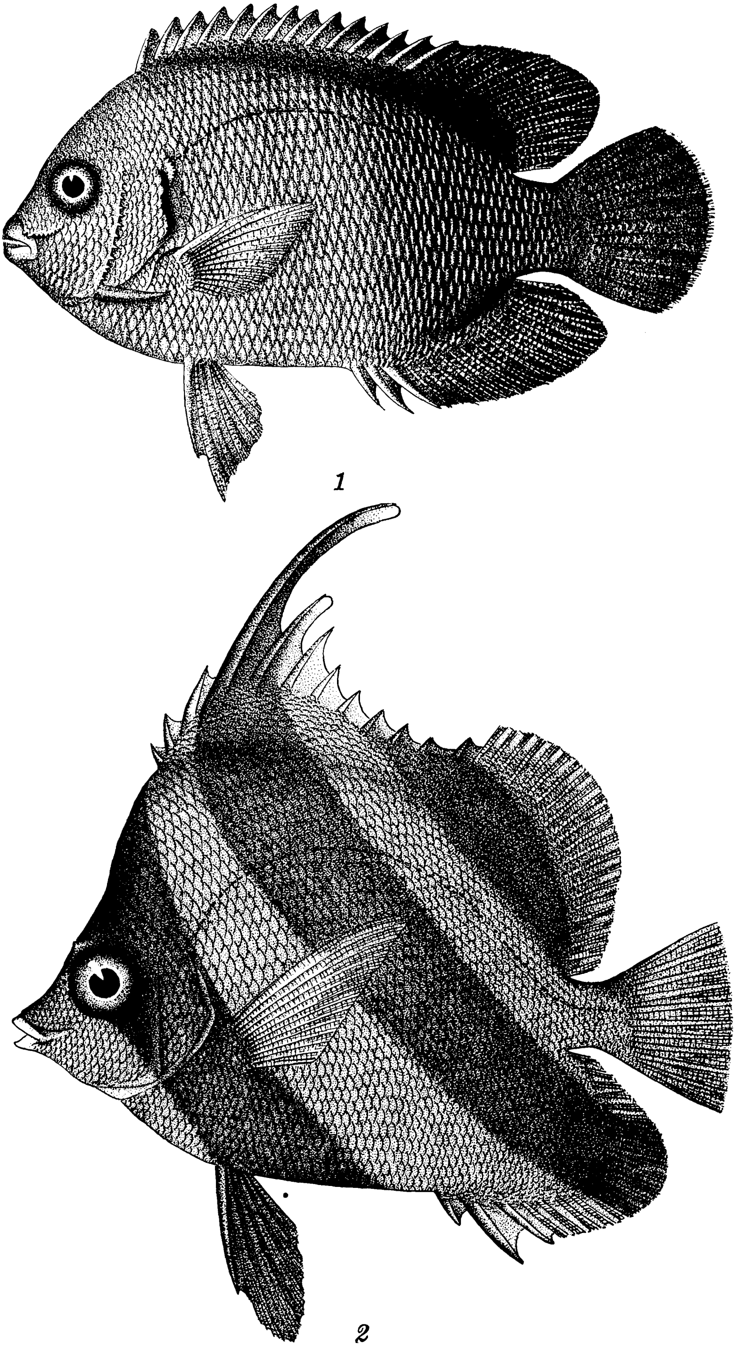

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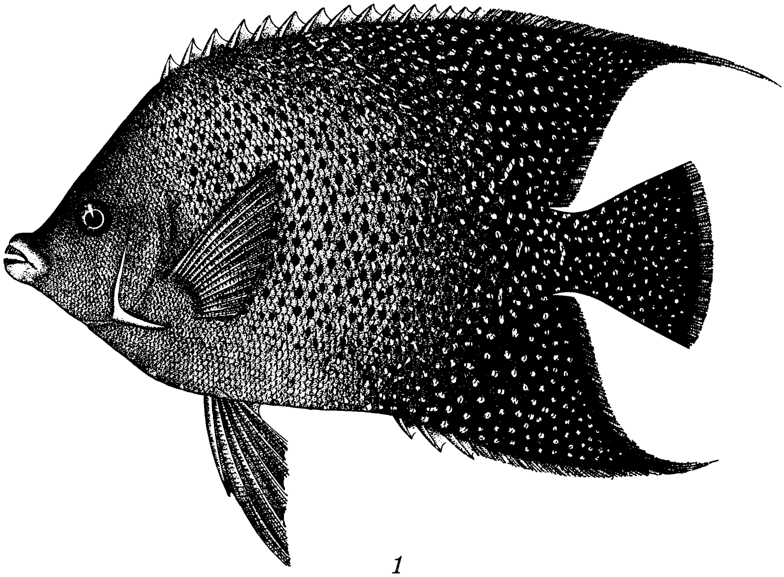

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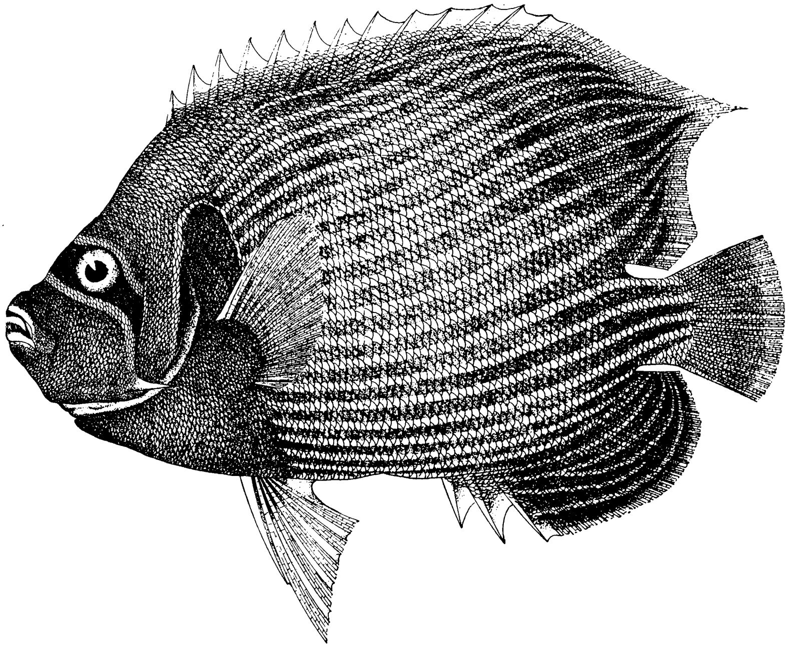

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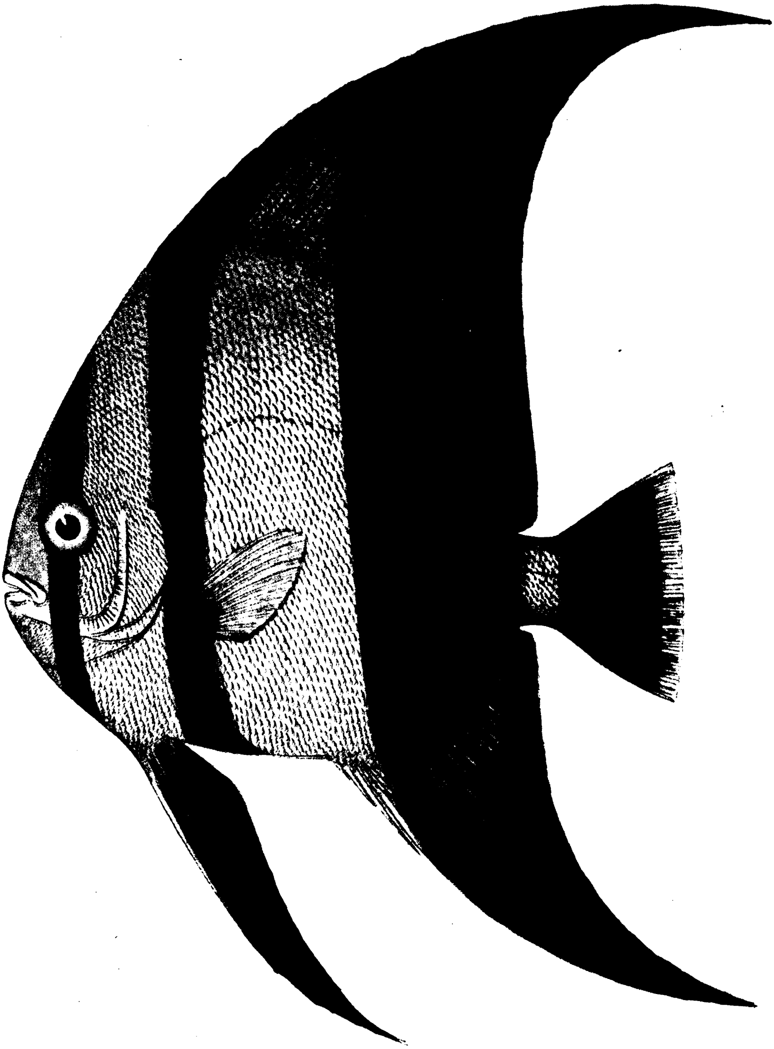

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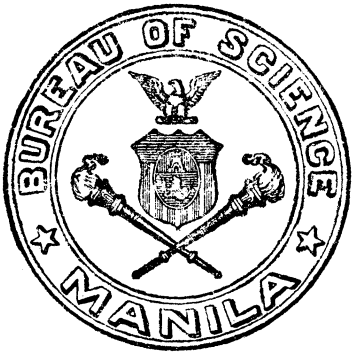

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THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 34 OCTOBER, 1927 No. 2

TRANSMISSION OF SURRA AMONG ANIMALS OF THE EQUINE SPECIES[1]

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Member, United States Army Medical Department Research Board

TWO PLATES

While nearly a half century has elapsed since Griffith Evans(1) discovered that surra was due to a trypanosome, the precise way in which the infection is commonly transmitted from animal to animal is still more or less of a question and the subject of considerable contention. True, it is generally accepted that the disease is conveyed through the agency of biting or blood-sucking insects, and in this connection most investigators consider flies the important agents. However, one has but to peruse the literature to find that practically every biting or blood-sucking pest of horses, cattle, buffaloes, camels, dogs, etc., in surra districts has, at some time, been looked upon with suspicion by one investigator or another in connection with the transmission of surra.

Though it is conceded that flies are the probable important transmitting agents, there is considerable disagreement as to which species can and which cannot convey the infection. Further, it has not been satisfactorily settled whether transmission is purely mechanical or a result of cyclic development of the trypanosome within the body of the fly.

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[1] From the United States Army Medical Department Research Board, Bureau of Science, Manila.

In 1901 Rogers,(2) impressed by the finding of Bruce that *Trypanosoma brucei* of nagana was conveyed from one animal to another by the bite of the tsetse fly, conceived the idea that surra among horses in India might be transmitted in a similar manner. Accordingly, he conducted a series of surra transmission experiments, using dogs and rabbits and "horseflies." The flies were caught, allowed to bite an animal whose blood contained large numbers of trypanosomes, and then after varying periods of time allowed to bite normal animals. Rogers stated his results as follows:

> In every case in which the flies had been kept from one to four or more days after biting the infected animals, no disease ensued in the healthy ones. Many such flies were dissected and microscopically examined, but in no case was anything found which might be taken for a development of the trypanosome in the tissues of the insect treated. * * * When, however, flies which had just sucked infected blood were immediately allowed to bite another healthy animal, positive results were obtained after an incubation period corresponding with that of the disease produced when a minimal dose of infected blood is inoculated into an animal of the same species. The result was uncertain if only one or two flies were allowed to bite, and especially if they were allowed to suck as much blood as they wished without being disturbed. If, on the other hand, several flies, which had just sucked an infected animal, were induced to bite a healthy one, and especially if they were disturbed and allowed to bite again several times, infection was always readily produced in both rabbits and dogs.

Rogers failed to indicate the species of fly he worked with, merely referring to it as a "horsefly." His is the first record reporting flies as transmitting agents in surra.

The year following Rogers's report, Curry, of the United States Army Medical Corps,(3) published an article on surra in the Philippines and announced that from observations he was convinced that *Stomoxys calcitrans* was the common vector of the disease. Apparently no experimental transmission work was done to substantiate his belief.

In 1903 Schat,(4) working with surra in Java, reported flies of the genera *Stomoxys* and *Lyperosia* as important disseminating agents of the disease in that country.

Musgrave and Clegg,(5) in 1903, concluded that the disease was conveyed through wounded surfaces, in which biting insects, particularly flies and fleas, served as the principal agencies. *Stomoxys* and *Tabanus* were both considered of importance.

In an article published in 1905 Manders(6) states that surra on the Island of Mauritius is "almost certainly" conveyed by *Stomoxys geniculatus*.

In 1908, Fraser and Symonds,(7) working in the Federated Malay States, reported the mechanical transmission of surra with several species of Tabanidæ. They failed to transmit the disease in similar experiments in which *Stomoxys* and *Hæmatopota* were employed. Experiments for the purpose of demonstrating whether species of *Tabanus* could transmit the disease in any but a mechanical manner were negative.

Leese,(8) in a summary of his work (1909), says in part:

> I consider it well established, therefore, that *Tabanus* is the most dangerous transmitting fly and that *Haematopota* (large species) is also dangerous. I believe too that *Stomoxys* is involved in a considerable degree in the transmission of surra * * *.

As regards *Lyperosia* he states that—

> circumstantial evidence points to their share in mechanical transmission as being very insignificant, if any.

Leese failed to transmit the disease in any but a mechanical way.

In 1911 Gaiger(9) referred to surra being prevalent when Tabanidæ were not found, and stated that species of *Stomoxys* were probably equally capable of transmitting the disease mechanically.

Baldrey,(10) in 1911, conducted experiments with *Tabanus* and *Stomoxys* with a view of determining whether or not a life cycle of the parasite occurred in flies of these genera. While his feeding experiments were negative, he observed, microscopically, what he believed to be evidence of cyclic development in the flies and expressed the opinion that the trypanosome "was either arrested or that the cycle is completed in another way, probably through the egg of the fly or by a second cycle through a mammalian animal." The "stages" in the life cycle observed by Baldrey were probably degenerative forms.

In an editorial appearing in a bulletin(11) of the Sleeping Sickness Bureau in 1911, the following statement is made:

> Even if the mechanical theory of transmission is satisfactory in explaining some epidemics of surra, this does not exclude the possibility that a development occurs in some invertebrate host. Since *Trypanosoma lewisi* has its cycle in the flea, fish trypanosomes their cycle in leeches, various trypanosomes of animals and *Trypanosoma gambiense* their cycle in tsetse-flies, it does seem probable that the same holds good for *Trypanosoma evansi;* but to say this is not to say that direct transmission never occurs.

Laveran and Mesnil(12) in their Trypanosomes et Trypanosomiases state that *Stomoxys* is looked upon as a potent factor in surra transmission.

Leese,(13) in 1912, reiterated his belief in the mechanical transmission of surra and again reported Tabanidæ, *Haematopota,* and *Stomoxys* as transmitting agents. He indicated, however, that he believed Tabanidæ to be the most important.

In 1912 Mitzmain,(14) in a series of well-planned experiments, obtained a single positive result in attempts to transmit surra with laboratory-bred *Stomoxys calcitrans.* The positive result followed in a case where a succession of two hundred and six interrupted bites were inflicted by flies transferred immediately from an infected to a normal animal. Tests for cyclic development of the trypanosome in the fly were negative, some of the flies used being kept as long as ninety-four days.

Mitzmain,(15) in 1913, conducted a series of experiments with laboratory-bred *Tabanus striatus* and in three cases succeeded in transmitting the disease with these flies. In one test a monkey was infected by three flies which had been interrupted after starting their feed on an infected guinea pig. In the other two cases, horses were infected by two and six flies, respectively, which had just previously started to feed on an infected horse. Cyclic transmission experiments with Tabanidæ were all negative. In the latter connection the flies were all laboratory bred and were kept for as long as twenty-six days after an infectious feeding. No developmental forms were recognized microscopically.

In 1914 Mitzmain,(16) in another publication, indicated his failure in surra-transmission experiments with *Aëdes* and *Culex* mosquitoes. He noted that mosquitoes harbor viable trypanosomes for a longer period of time than does any other blood-sucking insect with which he worked. Mitzmain also failed to produce surra in healthy animals through the agency of *Lyperosia exigua* and with blood-sucking gnats (*Culicoides judicaudus*).

Castellani and Chalmers,(17) in the 1919 edition of their Manual of Tropical Medicine, make the statement that *Stomoxys calcitrans* "is suspected of spreading trypanosomes, especially *T. evansi.*" They further indicate that the trypanosome appears to develop in various species of *Tabanus* and *Stomoxys.* In addition to flies, they state definitely that fleas can transmit the infection.

Herms,(18) in his Medical and Veterinary Entomology, published in 1923, quotes Mitzmain's results in transmitting surra with *Tabanus striatus* and agrees that *Stomoxys calcitrans* is of no practical importance as a carrier of the surra trypanosome. Herms states that "the *Stomoxys* fly has been regarded by some authors as an important carrier of this trypanosome. Unfortunately there is little or no conclusive experimental evidence in favor of this theory."

Cross,(19) in 1923, obtained positive results in ten out of fifteen experiments with *Tabanus albimedius* in interrupted feeds. In additional experiments, flies (*T. albimedius*) were fed on surra-infected animals and then, after periods varying from one to four days, were fed on healthy animals with negative results.

Working with ticks (*Ornithodorus crossii*), Cross failed to infect by the interruption process of feeding. However, he reports positive results in two instances out of twenty in which time was allowed for cyclic development of the surra trypanosome within the tick. The interval between feeding the ticks on an infected dog and feeding them on normal animals was one month in one case and seventeen days in the other. In this experiment the blood of the dog on which the ticks were initially fed contained numerous trypanosomes. In another series of experiments, in which the infected dog showed no trypanosomes in the circulating blood, one positive result was obtained by feeding ticks on a white rat one month following the feed on the dog. Cross concludes that ticks are incapable of spreading surra by direct transmission, but indicates that there is probably a cyclical development of the trypanosome within the tick.

In 1924 Yamasaki,(20) in an article entitled "Trypanosoma evansi und die mechanische Übertragung der pathogenen Trypanosomenarten," argues in favor of mechanical infection of vertebrate hosts.

Craig,(21) in his work on protozoa published in 1926, states:

> The exact method of transmission of *Trypanosoma evansi* is still unknown, although many insects have been suspected. In the Philippines a careful study of the transmission of the infection led me to believe that *Stomoxys calcitrans*, the common stable fly, was the transmitting agent. There is little doubt that the trypanosome is transmitted mechanically by various species of *Tabanus* and *Stomoxys*, and Mitzmain, in the Philippines, has obtained successful infections in animals through the bite of *Tabanus striatus*. There is no evidence that the trypanosome passes through a cycle of development in these flies, but the evidence is conclusive that infection may occur directly by their bites provided not too long an interval is allowed between an infected feed and the biting of the uninfected animal.

Hutyra and Marek,(22) in their latest edition of Pathology and Therapeutics of the Diseases of Domestic Animals, in treating of trypanosome diseases state that—

> natural infection in the domestic animals, exclusive of dourine in which it occurs by coitus, usually results from the stings of flies, namely, *Glossinae, Tabanidae* and *Stomoxys* species. Transmission is accomplished in such a manner that the flies take up the trypanosomes while sucking blood from infected animals, which then multiply in their intestinal tract, undergo morphological changes in the same, penetrate the salivary glands and from here reach the body of another vertebrate host with the saliva when the fly again sucks blood from such animal. The different species of trypanosomes are not dependent upon certain species of biting flies, but the different species of flies, especially *Glossinae* may become infected with different trypanosomes pathogenic for mammals. A direct, purely mechanical transmission without a change of generation is doubtful according to the results of more recent investigations.

In another section, in treating of surra, Hutyra and Marek state:

> It has not up to date been determined whether flies transmit trypanosomes in a purely mechanical way, or whether the parasites, similar to the trypanosome of nagana pass through a generative stage in the tsetse fly.

Wenyon,(23) in his Protozoology published in 1926, states:

> It will thus be seen that up to the present the only known method of transmission of *Trypanosoma evansi* in nature is a mechanical one, in which various biting insects inoculate healthy animals within a short time of their having fed on infected ones. It would seem very probable, however, that this is not the whole story, and that further research will reveal some form of development in the fly, leading to a permanent infection similar to that which occurs in various species of *Glossina* in Africa.

In going through the literature and in conversations with persons interested in surra one soon becomes aware that possible analogy between the mode of transmission of human trypanosomiasis (sleeping sickness), nagana of lower animals, and surra has been a potent factor and influence in accepting or rejecting reports on surra transmission. In other words, failure definitely to incriminate an intermediate host in which the surra trypanosome undergoes developmental stages previous to its transmission to other animals has, purely as a result of comparison with other trypanosomiases, caused a number of investigators to take a skeptical attitude toward reports which point to direct, mechanical transmission of the disease. Such individuals practically all take the position that, while some cases of surra may be the result of direct mechanical infection, the common mode of infection will sooner or later be found to follow cyclic development of the parasite in the body of the vector, as is the case in human trypanosomiasis, nagana, malaria, yellow fever, dengue, etc.

I have no hesitancy in stating that I leaned toward the latter view when the present reported work was initiated. The thought which immediately presented itself was that it was certainly not in accord with usual biological procedure for a protozoan organism as complex as the surra trypanosome to have to depend upon accidental mechanical transmission for its perpetuation. However, the investigations herein recorded have forced a change of attitude in so far as the transmission of surra to animals of the equine species is concerned.

SURRA TRANSMISSION EXPERIMENTS WITH STOMOXYS CALCITRANS

Stomoxys calcitrans is a well-known, common, and widely distributed blood-sucking fly pest, particularly of equine species and, as already indicated, has been held by a number of investigators to be an important factor in the spread of surra.

Several transmission tests were conducted with this fly. The first attempts to convey the disease with *Stomoxys calcitrans* were carried out with wild flies. However, as this species is easily reared under artificial conditions, the use of wild flies was discontinued and those raised in the laboratory were substituted.

The method of breeding the flies consisted in placing a number of females in quart fruit jars containing from 1 to 1.5 inches of guinea-pig fæces. The tops of the jars were covered with gauze. A small amount of water was added to insure sufficient moisture. After several days the flies were found to have laid eggs and died. The jars were then placed in the incubator at 37.5° C. and maintained there until the eggs hatched and the resultant larvæ passed through the pupal stage and emerged as mature flies. This entire process required approximately fifteen days. During the time the jars were in the incubator a few drops of water were added to the manure from time to time to maintain an ample amount of moisture. After the flies emerged they were collected and maintained individually in cotton-stoppered test tubes. Each test tube contained a piece of filter paper to control moisture. The flies used in experiments were transferred to fresh tubes at least every other day; in some instances every day.

In carrying out the transmission tests the flies were applied one at a time to the test animals by removing the cotton plug of the tube and quickly inverting the tube over the shaved area of the skin of the animal. By keeping the flies in individual tubes they live longer. Further, this method of applying them to the animal permits of an accurate check on the number that bite.

In one experiment thirty flies were fed on a surra-infected white rat each day, commencing the day following infection of the rat and continuing up to the day the rat died (sixth day). These flies were then fed daily on a normal white rat over a period of twenty-seven days, when the last of the flies died. Examination of the blood of the rat every other day over a period of thirty-one days subsequent to the last fly bite failed to demonstrate trypanosomes. The rat was then given an injection of blood containing *Trypanosoma evansi*, to prove its susceptibility. It promptly developed surra and died on the seventh day, its blood at the time of death containing swarms of trypanosomes. This experiment indicates that the surra trypanosome is not transmitted by *Stomoxys calcitrans* following cyclic development of the organism within the fly.

With a view of determining whether or not *Stomoxys calcitrans* could transmit surra mechanically, twenty-two flies of such species were fed back and forth on an infected white rat and on a normal one. The blood of the infected rat was swarming with trypanosomes at the time of the experiment. In this test a fly was permitted to bite the infected rat and to start drawing blood. It was then disturbed by tapping the tube and immediately transferred to the healthy rat and permitted to bite it and start to suck blood. It was then disturbed and placed on the infected animal, allowed to bite and commence taking blood when it was again disturbed and placed on the normal animal. By this procedure the fly would bite each rat two or three times before completing its meal. This practice was followed with all of the twenty-two flies. After the flies had all fed a number of them were crushed on slides and examined microscopically and their stomach contents found to contain large numbers of trypanosomes.

The normal rat was kept for fifty-six days without showing evidence of disease, microscopic examination of the blood at frequent intervals failing to reveal trypanosomes. To prove its susceptibility it was then inoculated with blood containing *Trypanosoma evansi*. It developed surra in four days and died on the eighth day.

In another experiment fifteen flies were fed back and forth on an infected rat and on a normal one, in the manner described above, on each of four consecutive days. The results were negative.

In still another experiment twenty flies were fed back and forth each day on an infected rat and on a normal one, the feedings being continued from the day following infection of the rat until the seventh day, when the infected rat died. The disease was not transmitted to the normal rat, which was kept under observation for over three months. It was then artificially infected and died of surra.

These experiments indicate that *Stomoxys calcitrans* does not commonly transmit surra in a mechanical manner.

SURRA TRANSMISSION EXPERIMENTS WITH LYPEROSIA EXIGUA

Lyperosia exigua (buffalo fly) is very common in the Philippines and, in so far as cattle and carabaos are concerned, is more of a pest than *Stomoxys calcitrans.* It can be found throughout the year and has frequently been considered a factor in surra transmission.

In carrying out transmission experiments with this fly the same procedure as was employed with *Stomoxys calcitrans* was followed. The first experiments were conducted with wild flies but, later, those bred in the laboratory were employed. The flies were kept separate in individual test tubes and applied one at a time on infected and susceptible animals.

In the first experiment thirty-five wild flies were caught and placed in individual test tubes. The following day six were found dead. The remaining twenty-nine were given an opportunity to feed back and forth on an infected white rat and on a normal one. Twenty-six of the flies fed, the remaining three refusing to bite. The next day four of the twenty-nine flies were found dead. The remaining twenty-five were again fed back and forth between the infected and the normal rats. All of the flies bit. The normal rat was observed over a period of one month, frequent blood examinations being made for the detection of the presence of trypanosomes, with negative results. Following artificial inoculation with blood containing *Trypanosoma evansi* the rat promptly developed surra and died.

A second experiment was conducted with *Lyperosia exigua* in which twenty-five laboratory-bred flies were fed back and forth, on each of three consecutive days, on an infected white rat and a normal one. The normal rat was kept under observation forty-one days, and frequent blood examinations were made. It failed to develop surra, but when inoculated with a small amount of blood containing *Trypanosoma evansi* promptly developed the disease and died as a result thereof.

In a third transmission test twenty-seven laboratory-bred flies were fed, on each of three consecutive days, on an infected white rat and on a normal one. The blood of the normal rat was examined frequently over a period of thirty days with no evidence of infection. This rat was then kept for approximately two months when it was artificially infected with surra and then treated with a trypanocidal chemical prepared by Doctor Loevenhart, of the University of Wisconsin. A cure resulted and the rat survived for over six months when it gave birth to a litter of young and died following complications in connection with parturition. Repeated blood examinations made up to the time of the death of this rat were negative for trypanosomes.

With a view of demonstrating possible cyclic development of the surra trypanosome in *Lyperosia exigua*, thirty laboratory-bred flies were fed on a surra rat from the day following infection up to and including the fourth day subsequent thereto, when the infected rat was found to have a considerable number of trypanosomes in the circulating blood. Following this the flies were fed daily on a normal rat over a period of nine days, when the last of the flies died. The normal rat was subjected to frequent blood examinations over a period of thirty-two days subsequent to the last fly bite. It failed to develop surra and was then inoculated with blood containing *Trypanosoma evansi*, following which it promptly developed the disease and died.

It would have been desirable to keep the flies over a longer period of time in tests for cyclic development, but it was found impossible to maintain them in captivity, even when bred in the laboratory, for more than approximately two weeks.

These tests indicate that *Lyperosia exigua* does not commonly transmit the surra trypanosome mechanically. In so far as transmission following cyclic development of the trypanosome in the fly is concerned, our experiments, as far as they went, were negative.

TABANUS STRIATUS IN SURRA TRANSMISSION

Following the completion of the transmission experiments with *Stomoxys calcitrans* and *Lyperosia exigua*, the large horsefly *Tabanus striatus* was scheduled for investigation. Work with this fly would have been started previous to the investigation of *Stomoxys calcitrans* and *Lyperosia exigua,* but at the time the surra-transmission studies were undertaken *Tabanus striatus* was exceedingly hard to find. Mitzmain(24) states that in the vicinity of Manila *Tabanus striatus* is prevalent from October to March. The period of prevalence, however, undoubtedly varies considerably in different years. During 1926, for example, *Tabanus striatus* commenced to make its appearance in and around Manila in appreciable numbers during the latter part of July. By the middle of August great numbers of these flies were in evidence.

In August, 1926, a serious outbreak of surra occurred among the horses and mules at Fort William McKinley, a United States Army post located about 8 kilometers from Manila. This outbreak afforded an excellent opportunity for study of the disease under natural conditions and in connection therewith the rôle of *Tabanus striatus* in the transmission of the disease was well established and further substantiated by experimental evidence.

In connection with the Fort McKinley outbreak, it should be pointed out that the best of conditions existed for an accurate epidemiological study. All animals on the post were under constant, competent veterinary supervision, and complete and definite information was available as to where the different animals had been quartered, contacts they had been subjected to, etc. As the data obtained from the study of the outbreak of surra there afford abundant evidence of the part *Tabanus striatus* played in the spread of the disease, a detailed description of the outbreak follows.

The first case of surra at Fort William McKinley was discovered on August 23, 1926. Three or four weeks previous to the discovery of this case, one of the veterinary officers from the post brought to the Medical Department Research Board, for identification, a species of fly which had started to make its appearance in various places about the post. I identified this fly as *Tabanus striatus* (Plate 1).

The case of surra discovered on August 23 was a mule in the Service Company, 45th Infantry. The previous sick record of this animal showed that it had been in the isolation ward and corral of the Veterinary Hospital from June 27 to August 19, 1926, undergoing treatment for epizoötic lymphangitis. Thus, it had only been back in its own organization (Service Company, 45th Infantry) four days when it was found to have surra. It was evident, therefore, that this animal had become infected while in the isolation ward and corral of the Veterinary Hospital. This fact immediately led the veterinary officers to make an examination of twenty-five animals then remaining in the isolation ward and corral. As a result of this and subsequent examinations, between August 24 and September 16, 1926, twenty-three cases of surra were found to have developed among these twenty-five animals.

The isolation ward and corral of the Veterinary Hospital are located but a very short distance from Pasig River. *Tabanus striatus* breeds along the shores of this river. Further, carabaos and oxen, a large percentage of which have been found to be carriers of the surra trypanosome, are commonly seen in the river in this locality and frequently pass along the road which parallels the stream. Another important point is that the isolation ward and corral are located at the edge of a small ravine which drains the surrounding area. This ravine contained a growth of bamboo which extended up to the isolation corral and overhung the fence. This bamboo jungle was found to harbor hordes of *Tabanus striatus,* large numbers of which fed on the horses and mules in the corral. A further interesting finding was that, unknown to the veterinary authorities, the military police had constructed a small corral in the midst of this bamboo jungle for the impounding of carabaos found loose on the military reservation. While hidden from view, this impounding corral was not more than 100 to 150 meters from the isolation corral.

The activity of *Tabanus striatus* among the horses in the isolation corral was carefully observed on several occasions. It was noted that, when this species of fly alighted on a horse standing quietly in the corral, it caused the animal great concern and almost invariably gave rise to movements which resulted in the insect flying off to attack a neighboring horse. A number of flies thus disturbed in their feeding were observed to bite two or three horses in the course of a minute or two.

The first case of surra discovered had mingled with one hundred thirty-eight animals in the 45th Infantry corral for four days. However, no cases of surra developed among these contacts. The area of the 45th Infantry is located approximately 1.2 kilometers from the Veterinary Hospital area. At no time were flies of the species *Tabanus striatus* observed in this area, although frequent careful search for them was made. On the other hand, *Stomoxys calcitrans* was present in large numbers.

On August 12, 1926, an animal under treatment for epizoötic lymphangitis was removed from the isolation corral of the Veterinary Hospital and returned to its organization, the 34th Ambulance Company. On August 31, 1926, this animal was examined and found to have surra; its blood was swarming with trypanosomes. From the evidence at hand, it was obvious that this animal had been infected while in the isolation ward and corral of the Veterinary Hospital. After being returned to its own organization, it was in close contact with approximately sixty-one animals for nineteen days. Only one case of surra developed among the contacts. The area occupied by the 34th Ambulance Company is about a quarter of a mile from the Veterinary Hospital area, and it is significant that *Tabanus striatus* was but rarely seen in this area.

On August 12, 1926, three animals which had been under treatment for epizoötic lymphangitis were discharged from the isolation corral of the Veterinary Hospital to the 23d Wagon Company. On August 31, 1926, blood specimens from these three animals were examined by Fort William McKinley veterinary officers and two were found to have surra. Two days later (September 2, 1926) the third animal was found to have the disease. The 23d Wagon Company had approximately two hundred sixty animals which were in contact with the cases sent from the veterinary isolation corral. Between September 2 and September 18, 1926, a total of sixteen cases of surra developed among the contacts. The 23d Wagon Company occupied an area about 410 meters from the veterinary isolation ward and corral, and its area was one of the localities where large numbers of *Tabanus striatus* were constantly found. A heavy bamboo growth, somewhat similar to that adjacent to the veterinary isolation ward and corral, was located in close proximity to the 23d Wagon Company's corral and afforded a favorable resting place for *Tabanus striatus.*

The contact animals of the 34th Ambulance Company and those of the 23d Wagon Company were moved from their respective areas to a rifle range about 1.6 kilometers from the post proper. On the range they were placed in small groups on picket lines, each line being separated from the others by at least 150 feet.

Because of the absence, in the area of the Service Company, 45th Infantry, of *Tabanus striatus,* to which all evidence pointed as the transmitting agent, it was decided not to move the animals of the Service Company unless a case developed among the contacts. Of course, daily blood examinations were made of these animals as also of all contacts in the other groups. Although, as previously indicated, the original case of surra was discovered in a mule returned from the isolation corral of the Veterinary Hospital to the Service Company, 45th Infantry, no cases developed among the contacts in the latter organization.

The twenty-five animals in the isolation ward and corral of the Veterinary Hospital at the time of the discovery of the initial case were not removed to another location, for several reasons. In the first place, the evidence was definite that the infection had its origin in this group of animals. It appeared obvious, therefore, that a number of the animals in this group were possibly in the incubative stages of the disease. Subsequent developments proved the accuracy of this belief. In view of these circumstances and considering that the group was small, it was decided to allow them to remain where they were rather than run the risk of introducing a number of potential cases of surra in the area selected for the isolation of other contacts.

The bamboo jungles in the region of the isolation ward and corral of the Veterinary Hospital and in the locality of the 23d Wagon Company were cleared and drained by engineer detachments. During the clearing of these areas, large numbers of *Tabanus striatus* were encountered.

In order to remove the menace of carabao carriers, a post order was promptly issued prohibiting carabaos from coming on the military reservation.

After the animals had been moved to the rifle range, it was discovered that a few Tabanidæ were present in this region. However, by segregation of the animals in small groups, daily blood examinations of all animals, and prompt destruction of cases as soon as found, there was no great opportunity for the spread of the disease. As a matter of fact, of the cases discovered among the animals of the 23d Wagon Company after their removal to the range, the time element indicated very definitely that, in all but one or two instances, infection must have occurred before arrival on the range. In the one or two cases which showed up a little later, it is entirely possible that they too were already actually infected when taken to the range. As noted, only one case of the disease developed among the contacts in the 34th Ambulance Company before their removal to the range, and no cases occurred after they were placed on the range.

After the outbreak at Fort McKinley had gotten under way, transmission experiments with laboratory animals were inaugurated, to substantiate the epidemiological findings. On August 31, 1926, eleven flies (*Tabanus striatus*) were caught in the region of the isolation ward and corral of the Veterinary Hospital, where cases of surra were still occurring among the horses and mules remaining of the original group of twenty-five. These flies were promptly taken to the laboratory and immediately given an opportunity to feed on a normal white rat, each fly being applied to the rat separately by means of test tubes. Of the eleven flies five, which had not obtained their fill on the horses, bit the rat and sucked blood. The other six flies were either engorged or were slightly injured when caught and therefore did not bite. Several of the flies which were engorged when caught and which did not bite the rat were killed and their stomach contents examined microscopically. In the stomach contents of one fly numerous trypanosomes, morphologically indistinguishable from *Trypanosoma evansi,* were demonstrated (Plate 2, fig. 1). On September 11, 1926, eleven days following the fly bites, the white rat was found to have trypanosomes in its blood (Plate 2, fig. 2). Four days later the rat died of surra. A guinea pig inoculated with a small amount of blood taken from the rat shortly before it died likewise developed the disease and subsequently died as a result thereof.

Shortly after the Fort McKinley outbreak was over, an additional surra-transmission experiment was conducted with laboratory animals. Eight female flies of the species *Tabanus striatus* were caught on the Fort McKinley reservation and fed back and forth on a guinea pig infected with surra and on three normal white rats. The guinea pig's blood at the time was found to contain a large number of trypanosomes. Two of the three rats developed surra as a result of the fly bites, one on the eleventh day following exposure and the other on the twelfth day. Both rats died of the disease, one on the fourth day following the detection of trypanosomes in the blood and the other on the sixth day. Guinea pigs inoculated with blood from these two rats likewise developed surra from which they eventually died.

With a view of demonstrating that *Trypanosoma evansi* transmits surra only in a mechanical way, after the eight flies above referred to had been fed back and forth on the infected guinea pig and the normal rats, they were given the opportunity on subsequent days to feed on a normal white rat without first biting an infected animal. This was continued up to the eighth day, when the last of the flies died. Only five of the eight flies bit during this period, the other three having died without having bitten again. The rat was observed over a period of several months, and there was no evidence of surra; it was finally inoculated with blood containing *Trypanosoma evansi,* and promptly developed surra and died as a result thereof.

It would have been desirable to conduct further tests with *Tabanus striatus* over a longer period of time to eliminate more definitely the possibility of cyclic development of the trypanosome within the fly. However, it was found impossible to keep wild flies alive for any great length of time, and the rearing of *Tabanus striatus* under laboratory conditions is exceedingly difficult. On the other hand, the evidence obtained on the mechanical transmission of surra by *Tabanus striatus* is quite definite. Further, the evidence obtained by Mitzmain with laboratory-bred *Tabanus striatus* was all against cyclic development of the trypanosome within the fly.

To summarize the situation, the outbreak of surra at Fort William McKinley coincided with the appearance of *Tabanus striatus* at various places on the post. It originated among animals in the isolation ward and corral of the Veterinary Hospital. This ward and corral adjoined an area which harbored hordes of *Tabanus striatus.* These flies had ready access to numerous carabaos, a large percentage of which have been demonstrated to be carriers of *Trypanosoma evansi.* The spread of the disease among animals which were in direct contact with cases from the isolation ward and corral depended upon the presence of *Tabanus striatus.* Experimentally, surra has been readily transmitted to normal white rats by the bites of *Tabanus striatus* when such flies have just previously fed on an infected animal.

The conclusion that the infection is spread in a purely mechanical manner by *Tabanus striatus* is further substantiated by several observations in connection with the Fort McKinley outbreak. With the clearing of the bamboo jungles in the vicinity of the veterinary isolation ward and corral and the 23d Wagon Company area, the flies promptly invaded other nearby localities on the post and were frequently seen attacking animals in the new localities. With an absence of cases of surra among such animals, the fly bites proved harmless. Then the rapid spread of the disease among the involved groups and its prompt termination when infected animals were promptly removed and destroyed are opposed to transmission after cyclic development of the trypanosome in the fly. With the large number of susceptible animals on the post (approximately 900), a vast number of Tabanidæ, and cases of acute surra to provide the source of infection, surra would have continued to make its appearance wherever these flies migrated had the infection spread as a result of cyclic development of the trypanosome within the fly. As a matter of fact, *Tabanus striatus*, in rather large numbers, could be found about the post for months after the outbreak; but, with no surra cases present and carabaos restricted from the reservation, the fly was not a menace.

SURRA TRANSMISSION EXPERIMENTS WITH MOSQUITOES

Most students of surra transmission have given thought to the possibility of mosquitoes acting as agents in the dissemination of the disease. Practically all reports on work done with mosquitoes have been negative.

The author conducted a series of transmission experiments with laboratory-bred *Aëdes ægypti* and in two instances obtained positive results in interrupted feeding tests. In one such test ten mosquitoes were fed back and forth, one at a time, on an infected white rat and on a normal one. As soon as the mosquito inserted its proboscis and commenced to draw blood, it was interrupted and placed on the normal rat and permitted to bite and draw a little blood. The interruptions were made at very short intervals, some of the mosquitoes biting six or seven times before becoming engorged. The mosquitoes were fed in this manner as often as they would bite during a period of eight days, the period terminating with the death of the infected rat. The normal rat exposed to the bites of the mosquitoes was found to have trypanosomes in its circulating blood sixteen days subsequent to the first bite, and it died six days later. A guinea pig and a dog inoculated with blood from this rat both developed surra and died as a result thereof.

In the second experiment in which positive results were obtained six mosquitoes were employed. They were fed back and forth on an infected rat and on a normal one in the manner above described, every day for six days, when the infected rat died. On the eighteenth day following the initiation of the test the originally normal rat was found to have trypanosomes in its blood. It died of trypanosomiasis eight days later. In the meantime a guinea pig was inoculated with a small amount of blood from this rat and it promptly developed surra from which it died approximately five weeks later.

A test was conducted with a view of determining whether or not *Aëdes ægypti* could transmit surra following cyclic development of the trypanosome within its body. Twenty mosquitoes of this species were placed, one at a time, on an infected rat daily from the day following the infection of the rat up to and including the sixth day, when it died. These mosquitoes all took blood the first day they were placed on the rat. None would bite on the second day, but on subsequent days they fed irregularly, a number on the third day, a few on the fourth, etc., up to and including the sixth day, when the rat succumbed. These mosquitoes were then fed, as often as they would bite, over a period of thirty-two days on a healthy white rat. The rat failed to develop surra and after being kept in the laboratory eighty-one days was artificially inoculated. It promptly developed the disease and died as a result thereof.

The two positive results obtained in our work point to the possibility of mosquitoes sometimes being responsible for cases of surra among animals. However, while it is probable that mosquitoes are responsible for the transmission of occasional cases of surra, it does not appear likely that they are a common factor in the spread of the disease under natural conditions. This is obvious when it is considered that the mosquito will ordinarily bite an animal, complete its meal, and leave without the animal being aware of it. Under such circumstances frequent interrupted feeding on several animals is not likely to be of common occurrence.

SURRA TRANSMISSION EXPERIMENTS WITH TICKS

Several series of experiments were conducted with ticks for the purpose of determining, if possible, whether or not such insects could transmit surra. The ticks used were *Boophilus australis* and *Dermacentor recticulatus.*

In one experiment thirty young female ticks (*Boophilus australis*) were removed from a "ticky" cow and half of them placed on a surra-infected dog and the other half on a rabbit infected with surra. Those placed on the rabbit would not remain. Those placed on the dog remained and commenced to suck blood. However, three or four of the ticks on the dog were lost as a result of the animal scratching. After being allowed to remain on the infected dog just long enough to insure that they had partaken of the blood containing trypanosomes, the ticks were carefully removed and placed on a normal dog. Several of the ticks were lost by the second dog, as only seven were found on the animal several days later. The normal dog was kept under observation for approximately six weeks and showed no evidence of surra, although frequent blood examinations were made. It was then artificially inoculated, promptly developed the disease, and died as the result thereof in about one month.

An experiment similar to the above was conducted with ticks of the species *Dermacentor recticulatus* removed from a dog. The results were negative.

Further experiments were conducted with ticks of the two species mentioned which were raised from eggs under laboratory conditions. These tests were all negative.

In addition, eggs from female ticks which had been permitted to suck blood containing *Trypanosoma evansi* were ground in a mortar with a small quantity of sterile physiological saline solution and injected subcutaneously into white rats. The results were negative. Further, "seed ticks" hatched from eggs laid by females which had fed on infectious blood were likewise ground in salt solution and injected into white rats. No infection resulted from such procedure.

RESERVOIRS OF TRYPANOSOMA EVANSI

Frequent mention is made in the literature of carriers of various pathogenic trypanosomes among water buffaloes, cattle, and various wild animals. In the Philippine Islands carabaos and cattle have from time to time been found to harbor *Trypanosoma evansi* without manifesting appreciable evidence of disease. Practically all Filipinos engaged in agricultural pursuits will state that, if horses are allowed to mingle continually with carabaos, sooner or later the former will develop surra. While a definite surra-carrier problem, particularly with carabaos, is thus recognized in the Philippines, a careful survey of the literature fails to give any idea as to what proportion of carabaos and cattle are carriers of the organism in question.

The usual method for the detection of carriers of trypanosomes has been to examine microscopically a drop or two of blood from the suspected animal. Under normal conditions, trypanosomes are very frequently present only in small numbers in the circulating blood of carriers or they may even be entirely absent from it for temporary periods. Thus, the microscopic examination of a drop or two of blood will, in many instances, fail to disclose a real carrier.

Observations have demonstrated that, when the normal resistance of a carrier is lowered, the trypanosomes will often be found in considerable numbers in the circulating blood, rapidly diminishing in number when the animal returns to its usual state of health. This is nicely illustrated by a study of a group of carabaos subjected to rinderpest vaccination by the simultaneous method. Twenty carabaos purchased in different parts of northern Luzon were assembled by the owner at the experiment station of the Philippine Bureau of Agriculture, for immunization against rinderpest. Microscopic examination of the blood of these animals revealed one carrier of trypanosomes. When injected with the rinderpest virus and serum most of these carabaos developed temperature reactions.

Examination of the blood during such reaction revealed four of the lot to be carriers of trypanosomes. With the termination of the reaction the trypanosomes soon became so scarce in the circulation that microscopic examination of a drop or two of blood failed to reveal their presence.

With a view of developing a more accurate means for determining whether or not an animal is a carrier of *Trypanosoma evansi*, the author introduced the use of the complement-fixation test. It was found that blood-serum specimens from carabaos and cattle harboring *Trypanosoma evansi* will give a positive reaction to the complement-fixation test for trypanosomiasis. The positive reactions were then checked, in a representative number of cases, by guinea pig-inoculation tests for the purpose of proving the accuracy of the test and identifying the type of trypanosome.

The antigen employed in the complement-fixation test is similar to that first described by Watson of Canada and later by Reynolds and Schoening(25) of the United States Bureau of Animal Industry. A description of the method of preparing it follows.

Ten or more white rats are inoculated subcutaneously or intramuscularly with blood from a previously infected rat whose blood is found to contain numerous trypanosomes. Rats are employed because trypanosomiasis in such rodents runs a short, acute course, the trypanosomes in the circulation increasing rapidly, so that in four or five days the blood is swarming with them. Death of the rats would ordinarily occur in from five to seven days, but they are not allowed to die. When the blood is found to be swarming with the organisms the rats are bled to death by severance of the carotid arteries and jugular veins after the animals have been stunned by a blow on the head. The blood is caught in approximately an equal part of 2 per cent sodium citrate in physiological saline solution. After the blood has been collected from all of the rats it is placed in one or more centrifuge tubes and centrifugalized at high speed for forty-five minutes. Examination will show the blood cells packed in the bottom of the tube, and on top of them a thin, white upper stratum consisting largely of trypanosomes. The supernatant fluid is drawn off, care being taken not to draw up any of the layer of trypanosomes. At one time it was the practice to collect carefully the white layer of trypanosomes with a small pipette and discard the rest of the material. It has been found, however, that a good many trypanosomes are contained in the mass of packed cells; so, instead of removing the white layer, distilled water is added to the cell mass in sufficient quantity to lake the red blood cells completely. The mixture is then centrifugalized at high speed for forty-five minutes. It will then be found that the trypanosomes have been "thrown down" in the bottom of the tube together with a little cell débris and possibly a few cells which escaped laking. The supernatant fluid is drawn off, care being taken not to get too close to the trypanosome mass. A little sterile physiological saline solution is added to the tube for the purpose of washing the trypanosomes, and the centrifugalization process is repeated. After this wash fluid is drawn off, one part of 50 per cent glycerine in physiological salt solution is added to one part of packed trypanosomes. This constitutes the stock antigen. If it is placed in a tightly stoppered test tube and maintained at a temperature around the freezing point, or even in a frozen state, it can be kept for a month or more. A satisfactory method is to place the tube of antigen in an ice-salt mixture and keep it in a refrigerator at low temperature, and renew the ice-salt mixture every day.

For use the stock antigen is diluted from 1 : 10 to 1 : 20 with sterile physiological saline solution and then titrated.

To date, in connection with carrier work, the complement-fixation test for trypanosomiasis has been applied to blood specimens from a total of 141 carabaos, 54 cows and bulls, and 228 horses, the latter animals having been in contact with surra cases.

The carabaos represented animals from different parts of Luzon. For example, one lot of carabaos tested was made up of animals purchased at thirteen different points in four provinces of Luzon. These animals were purchased at such points and shipped immediately to the experiment station of the Bureau of Agriculture at Pandacan, for immunization against rinderpest before being shipped south for work in the fields of a large sugar central. They were specially selected and to all outward appearances were fine specimens and in perfect health. Immediately after their arrival at Pandacan blood specimens were procured, which were subjected to the complement-fixation test for trypanosomiasis. Of the twenty animals, blood specimens from thirteen gave positive reactions to the complement-fixation test for trypanosomiasis. Guinea pigs inoculated with 10 cubic centimeters of blood from four of the thirteen reactors, picked at random, demonstrated the presence of trypanosomes. Blood from the guinea pigs was then inoculated into white rats, the latter animals dying of surra in from six to nine days.

It is of interest to note that when these twenty carabaos were given the simultaneous rinderpest vaccination, direct microscopical examination of their blood during the febrile reaction revealed numerous trypanosomes in the blood of four of those with the highest temperatures.

The above-described experience is representative of tests with other groups. Of the 141 carabaos tested to date, 73 gave positive reactions to the complement-fixation test for trypanosomiasis. Of the 54 head of cattle, 12 positive reactions were obtained. No carriers have been found among animals of the equine species. In such animals the disease runs a progressive course terminating in death within a few weeks.

It should be borne in mind that the complement-fixation test for trypanosomiasis will be positive if an animal is harboring or is affected with any type of trypanosome or trypanosome disease. However, in the Philippine Islands the only type of pathogenic trypanosome known to be present is *Trypanosoma evansi*. In one or two instances a cow or bull has been found to be harboring a large, nonpathogenic trypanosome similar to or identical with *Trypanosoma theileri*. This parasite, however, can be readily distinguished morphologically and, further, it cannot be propagated in guinea pigs or rats. For practical purposes a positive complement-fixation test for trypanosomiasis, obtained with blood specimens from carabaos and cattle in the Philippine Islands, can be considered as evidence that the animals from which the specimens were procured are carriers of *Trypanosoma evansi*.

DISCUSSION AND CONCLUSIONS

A survey of the literature on surra reveals that the precise method by which the infection is spread from animal to animal has not been conclusively settled to the satisfaction of all concerned. With the possible exception of Cross's work with ticks, there is no definite evidence whatever indicating the possibility of an insect vector spreading the disease after cyclic development of the parasite within its body. On the other hand, a number of investigators have reported success in the mechanical transmission of the disease by flies. Though it is accepted that flies are the agents commonly disseminating surra, there is considerable disagreement as to which species can and which can not transmit it.

Hesitancy to accept readily the evidence that the mechanical method of transmission is the common mode of dissemination of the disease among animals of the equine species is due to the inclination to draw an analogy between surra and other trypanosomiases and protozoan diseases in which it has been shown that infection does follow cyclic development of the parasite within the body of the insect vector.

As a result of the study herein reported the conclusion is drawn that the common disseminating agent of surra among animals of the equine species, in the Philippine Islands at least, is *Tabanus striatus*, and the mode of transmission purely mechanical.

It is entirely possible and perhaps probable that *Trypanosoma evansi* may be transmitted to a natural host in a manner more in conformity with what is ordinarily expected of a protozoan organism of such type or, in other words, following cyclic development of the parasite in an intermediate host. Thus, if the carabao, ox, or some wild animal is the natural host of *Trypanosoma evansi*, an intermediate agent may be found transmitting the infection after cyclic development of the trypanosome within its body. However, it is obvious that the horse is not the natural host of *Trypanosoma evansi*, as otherwise it would not be likely to suffer serious consequence as a result of the trypanosome's presence within its body. When *Trypanosoma evansi* does "accidentally" gain entrance to the body of an animal of the equine species disease promptly results. Thus, the common spread of surra among horses can be considered as merely incidental to the feeding habits of Tabanidæ, and the direct mechanical mode of transmission as entirely tenable.

Our experiments with *Stomoxys calcitrans* and *Lyperosia exigua* failed to demonstrate that either of these flies is a factor in surra transmission.

Experiments with the ticks *Boophilus australis* and *Dermacentor recticulatus* likewise failed to indicate that these insects were concerned in the dissemination of *Trypanosoma evansi.*

In two instances the surra trypanosome was transmitted to healthy white rats by mosquitoes of the species *Aëdes ægypti.* In these tests the mosquitoes were fed back and forth on infected and on normal rats. It is thus probable that mosquitoes may be responsible for an occasional case of surra. However, as a mosquito will usually bite a horse, complete its meal, and depart without the animal's knowledge, it is not probable that such insects are common factors in the spread of the disease.

In the Philippine Islands carabaos and, to a lesser extent, cattle are common reservoirs of *Trypanosoma evansi.* Under ordinary circumstances such animals usually show no impairment of health whatever as a result of the trypanosome's presence. On the other hand, when the normal resistance of the animal is lowered the surra parasite rapidly increases in number in the circulation and at such time the carrier is particularly dangerous.

Tests of one hundred forty-one carabaos from various parts of Luzon revealed over 50 per cent of the number to be carriers of the surra organism. Similar tests, conducted with fifty-four cows and bulls from several localities in Luzon, demonstrated about 22 per cent to be carriers.

The number and distribution of carriers of *Trypanosoma evansi* are another strong argument against the infection of animals of the equine species by permanently infected insect vectors. If surra were spread in such manner the equine population of the Philippine Islands would have been wiped out long ago.

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ILLUSTRATIONS

PLATE 1

Tabanus striatus, the common transmitting agent of surra among horses in the Philippine Islands.

PLATE 2

FIG. 1. *Trypanosoma evansi*, in stomach contents of *Tabanus striatus* caught on horse at Fort William McKinley.

2. *Trypanosoma evansi*, in blood of rat infected by bites of *Tabanus striatus* caught at Fort William McKinley.

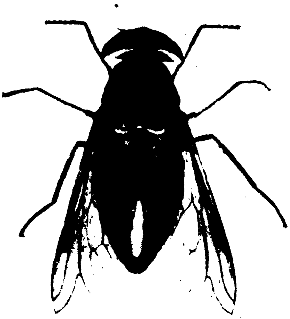

PLATE 1. TABANUS STRIATUS LINNÆUS.

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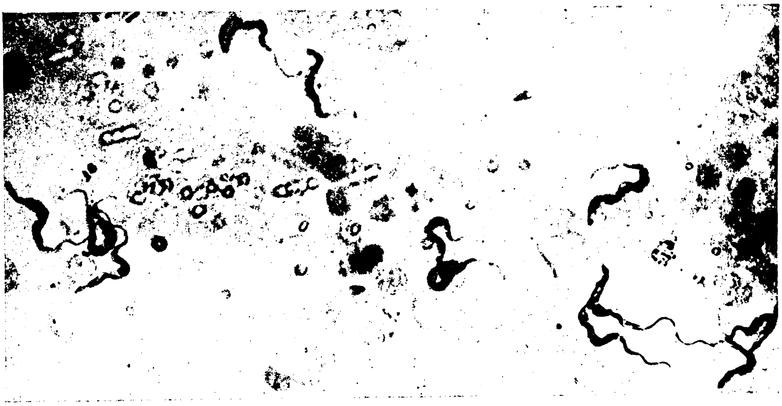

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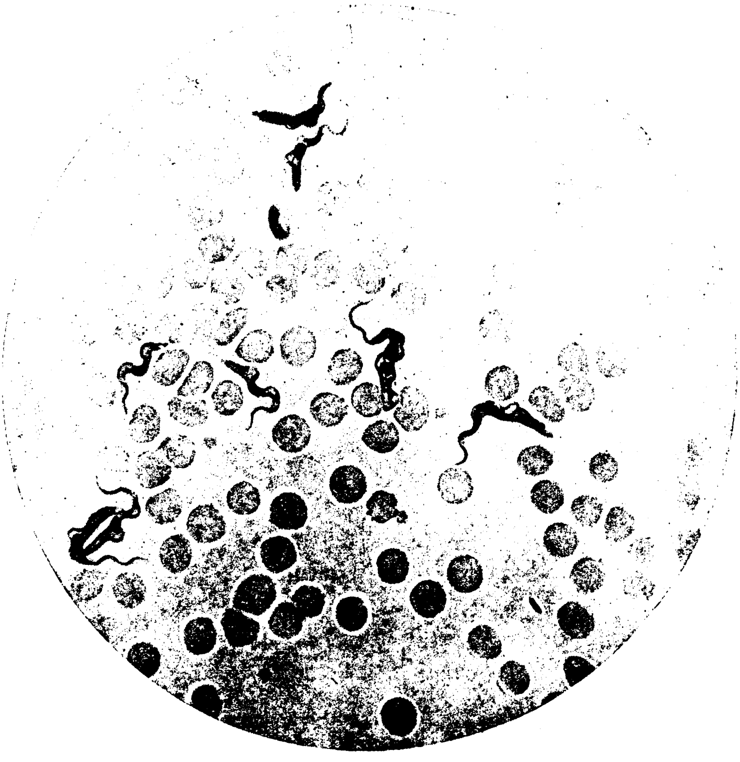

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PLATE 2. TRYPANOSOMA EVANSI.

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THE NEGROS EARTHQUAKE OF 1925

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and

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TWO PLATES

The present report is the result of observations made from November 26 to December 3, 1925, when the writers were in southeastern Negros, in response to the insistent request of the officials of Oriental Negros Province for information regarding the nature of the violent earth shocks which culminated on May 5, 1925, and the probability of recurrence.

The earthquake that occurred in southeastern Negros on May 5, 1925, will figure in the seismic history of the Philippines as one of the worst, not only for its extent but also on account of the destruction and casualties it caused. On March 1, 1922, just thirty-seven hours after the Cebu earthquake, southeastern Negros was shaken by violent shocks which caused some damage. These shocks did not attract much attention because the public was rather concerned by the Cebu earthquake. Three years later, in January and February, 1925, three series of moderate shocks took place. These were the forerunners of the more-violent earthquake of May 5, 1925, which caused the loss of some twenty human lives as well as considerable damage to property, particularly in Bais, Tanjay, Siaton, and Bayuan (Tolong).

GENERAL GEOLOGY

Southeastern Negros was a volcanic island which, by successive eruptions, was tied to the mainland of Negros by extrusives and ejectamenta. The cluster of volcanic peaks lies to the west of Dumaguete, and attains a maximum elevation in the Cuernos de Negros, or horns of Negros, which are 1,903 meters above sea level. Farther west from Dumaguete, some 20 kilometers from the coast, is Lake Balinsasayao, at an elevation of 976 meters. This lake and a smaller lake separated from it by a narrow wall occupy the basin of the crater of an old volcano. Both lakes are typical crater lakes, very deep near the center and more or less circular in plan, and their walls of volcanic materials rise precipitously to a great height. The larger lake has a maximum diameter of about 1.5 kilometers and a minimum diameter of about 1 kilometer. It is reported that the larger lake is about 375 meters deep, while the smaller lake is a little deeper, about 400 meters.

This crater has been inactive at least since the dawn of Philippine history. The only activity in the district on record was volcanic emanations from a small craterlike vent on the southeastern slope of the Cuernos de Negros, some 16 kilometers from Dumaguete, in a locality called Magaso. The continued inactivity is also evidenced by the fact that three or four small streams have already developed on the sides of the crater. It would appear that the lava of the chimney had consolidated into a volcanic plug, thus closing the bottom of the crater and permitting more accumulation of surface waters due to the fact that there was less seepage. Further testimony along this line of evidence is offered by Doctor Herre's observations as follows: [1]

> * * * The rocks where, up to two years ago, one formerly embarked, at the point where the lake is approached, are now submerged about 5 meters, and are 15 meters or more from the present shore line.
>
> Next to the water line was a belt of tree ferns ranging in height up to 5 or 6 meters and occupying the strip almost to the entire exclusion of other woody plants. These tree ferns have been killed by the rise in the water and now but a few dead ones, partially or totally submerged, are to be seen. * * * Since tree ferns are very slow-growing plants and live for centuries, it is likewise evident that the water line was for a long time much lower than it is at present.

Nearly all the streams in this part of Negros flow radially from near the central mass to the coast. In the gorge of one of these streams, in Ocoy River, a few kilometers north of Dumaguete, are hot springs. It will be remembered that hot springs, generally connected with uncooled masses of siliceous lava, are usually regarded as representing the last expiring stage of volcanic activity. There are no large rivers, and the streams are of nearly the same size and at about the same stage of development. The upper section of the streams consists of rapid waters capable of effective erosive work, while the lower section is sluggish and meandering, bordered by flood grounds.

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[1] Smith, Warren D., Geology and Mineral Resources of the Philippine Islands, Bureau of Science Pub. 19 (1924) 176.

The coastal plain is variable in development. In the region of Bais and Tanjay is a broad expanse of level land formed by flood plain and alluvial deposits of the Panambalon, Tanjay, and other rivers in a partly inclosed mountain valley. The coastal plain is at its maximum development in this region but becomes narrower southward to Dumaguete, and when Zamboanguita is reached it is merely a narrow strip of land. From Zamboanguita to Siaton the coastal plain is practically nonexistent. At Siaton the Siaton and Canauay Rivers have formed a small flood-plain deposit. From here to Tolong Viejo the hills are very close to the sea. At Tolong Viejo and Bayuan (Tolong) the physiographic counterpart of the Bais and Tanjay region is present, in which a partly inclosed mountain valley opening into the sea is filled with flood plain, alluvial fan, and delta deposits of the Bayuan, Sicopon, and other rivers.

The prevailing country rock of the hills and mountains is andesite, andesitic basalt, and normal basalt, representing different stages of volcanic flow. In a few places the weathered andesite resembles tuff. The saddle connecting the Cuernos de Negros with the main cordillera of Negros Island is composed in the main of volcanic tuff and other materials.

The geologic history of southeastern Negros can be briefly summarized as follows: A volcanic island, formed by successive volcanic eruptions, gradually increased its cone by continued eruptive activity, which may have begun late in the Miocene. In the course of the continued activity parasitic cones developed on the flanks and sides, and at times there was probably abnormal violence or collapse which destroyed the symmetry. It appears that there were also mud flows which buried older bowlders and gravels. In the cañon of Ocoy River rounded volcanic bowlders and pebbles can be seen embedded in the nearly vertical sides. The volcanic activity continued probably until late Pliocene, when the last product came in the form of ashes and dust which were afterward consolidated into tuff. With the cessation of eruptive activity began the formation of radial streams and gullies, and the more or less circular crater, now known as Lake Balinsasayao, began to fill with water. As the different cones were worn away by denudation, flood plain, alluvial, and delta deposits were formed, particularly in the mountain valley at Bais and Tanjay and across the peninsula at Bayuan (Tolong) and Tolong Viejo. The materials composing these river plains are in the main unconsolidated sediments, sand, gravel, and tuffaceous clay. The last stage in the history of southeastern Negros is the building up of fringing coral reefs along the coast, more particularly at those places where the swampy condition of the streams and the water-borne sediments do not interfere with the growth of corals.

EFFECTS OF THE EARTHQUAKE

With a knowledge of the general geology and geologic history of southeastern Negros it is not difficult to understand the selective destruction by the earthquake of May 5, 1925. The regions that suffered greatest destruction will be briefly described.

Bais.—The sugar central of the Compañia Tabacalera suffered great damage. At the main plant the steel columns supporting the tanks and evaporators were badly bent. While the earthquake shocks were in the main responsible for the damage, it is true that the loads were rather heavy for the supports and that substantial bracing with diagonal struts might have overcome the inertia of the loads during the horizontal movements. The other structures of the sugar central stood the vibrations well. However, a concrete pier belonging to the central was badly damaged. The columns supporting the pier had been driven in mud but there was no bracing of any kind. After the earthquake the floor of the pier was found inclined and all the columns were broken at the junctions that had no reënforcing knee braces. The mud into which the columns had been driven was so soft that afterward, by strong pulling, the pier was returned to its horizontal position. A concrete pier on mud foundation can hardly be expected to resist horizontal oscillations. Sections of the long causeway leading to the pier subsided, but these sections had rested on mud; the portions built on coral banks were not damaged.

Tanjay.—The Catholic church of Tanjay lost its magnificent-appearing front flanked by two high bell towers. The façade was constructed of a filling of mortar and soft stone with a thin facing of coralline limestone. It appears that the contractor embedded big wooden posts in an upright position in the corners of the towers. After the posts had decayed, they left empty spaces. The ruins also showed that the mortar was soft and porous, and that water, fungi, and plant roots had penetrated into the apparently massive work. It is not known why the contractor embedded the big posts; possibly, he believed they would serve as reënforcements. This practice, however, is not to be recommended because, with the disappearance of the posts by decay (which is to be expected), the whole structure is weakened, and before they disappear their vibrations tend to smash the surrounding mass. The convent of Tanjay, the municipal building, and several private houses built of wood suffered damage, but it was found that these were greatly in need of repairs and some of the posts had already been eaten by the destructive termites (*anay*).

Bayuan (*Tolong*).—Portions of the cane fields were raised and numerous cracks appeared in the ground, some of them large enough to admit carabaos and so deep that three or four of the carabaos that fell into the cracks had to be killed as they were unable to get out. Numerous coconut trees were uprooted and several were torn apart by the movement. The old chimney of the sugar mill tumbled at the first quake. Most of these chimneys (chimneys were damaged also in other places affected by the earthquake) were constructed of ordinary bricks or adobe stone, piled and held together by weak mortar and, after years of exposure, they were exceedingly weak and could not resist even slight oscillations.

Siaton.—The Catholic church, which was of stone construction, was badly damaged. The walls were built of smooth, round, river pebbles and weak mortar. The rather elaborate, arched front door had no arching properties and the whole arch structure fell at the first sign of movement. The supports, or piers, remained standing and were apparently able to withstand the shocks. The walls of the ground floor of the convent, built of similar river pebbles, were razed to the ground. The ruins formed a heap of clean pebbles and bits of mortar. All structures in the town that were built of the same materials, fortunately few, were ruined. The municipal building, of mixed construction consisting of concrete posts with wooden framing and roof trusses covered by a corrugated steel roof, suffered much damage. The concrete pillars, not braced together, supported the rest of the wooden structure and were broken at the junctions with the floors and the roof framing. The public school building, which likewise had concrete pillars with wooden beams, was also damaged; all of the pillars were broken at their bases. It appears that mixed construction of the kind mentioned will not vibrate consonantly as a single unit.

Other towns.—With the exception of slight damage in Zamboanguita, the rest of the towns in the district showed no signs of having been through an earthquake. The earthquake was felt in Bacong and Dumaguete, but no damage was sustained there.

Landslides and cracks.—From Siaton, Zamboanguita, and other places can be seen the scars of a number of large landslides on the sides of Cuernos de Negros. These are in the main due to earthquakes, but the immediate cause must be the effect of rain water which serves as a lubricant to the shaken mass. Shortly after the Cebu earthquake of 1922 an extensive landslide occurred on the side facing Zamboanguita, which destroyed caiñgin fields and swept away a man and a carabao plowing near the edge of the gulch; according to report, the man escaped without serious injury. Sometime after the earthquake of May 5 an extensive landslide occurred on Mount Gilagaon, which buried two or three houses, killing some twenty people.

The provincial roads were badly cracked and damaged in the parts built across inundated mangrove swamps; these parts subsided in several places. Due to the soft foundation the road materials tended to spread out, causing wide, lengthwise fissures. On the trail from Pamplona near Tanjay, across the peninsula to Bayuan, were numerous landslides and cracks; one particularly large crack, encountered before the sitio of Amio was reached, was a meter wide, some 50 meters long, and of unknown depth.

ORIGIN AND PROBABILITY OF RECURRENCE

The origin of the Negros earthquake of 1925 was the movement of the earth's crust along a seismotectonic line (marked GG on the map) extending from northwestern Samar and Leyte, crossing southeastern Negros in the region of Bais, Tanjay, and Bayuan (Tolong), and probably terminating west of Zamboanga Peninsula. The periodic movements were simply the result of readjustments of the land masses, which occur whenever there is sudden relief of strain when these pass the limit of equilibrium and the modulus of elasticity of the crust of the earth. The seismotectonic line marks in a general way the line of the fault, and movements along the fault plane take place whenever the stress exceeds the force of adhesion. It is not probable that earthquakes of greater intensity than that of the May earthquake will visit the district. Numerous slight shocks may be expected from time to time, as there are many places all along the fault line that do not show topographic adjustment, and there will probably be occasional tremors. It appears that this fault line is a broken line, and readjustment of the masses does not take place along an extended area. This assumption is confirmed by the fact that little or no effect was noted in other sections of the line northeast and southwest of Oriental Negros.

SUMMARY AND CONCLUSIONS

The earthquake of May 5, 1925, was of geologic, or tectonic, nature and, in our opinion, not so strong as some observers in the district would have us believe. The earthquake intensity was Grade VIII in the Rossi-Forel scale, which is described as "very strong shock, *fall of chimneys, cracks in walls of buildings.*"

In general, the destruction was not so much due to the earthquake as to faulty construction and want of repairs. The construction of high walls with smooth round pebbles and the use of poor materials were in the main responsible for the destruction of the stone buildings. Large wooden posts embedded in stone walls cannot be expected to play the part of reënforcing steel. It appears that buildings of concrete posts and wooden frames and floors are very poor earthquake-resistant structures, as they do not vibrate as a unit. The heavy loads placed on the upper structures of the sugar centrals require much heavier and more substantial supports and braces.

Sections of roads constructed by filling up portions of muddy inundated areas are easily damaged by earthquakes, on account of the soft foundation. Any road the materials of which are not properly pressed and rolled heavily to the very base will develop cracks upon being subjected to earth movements.

The most serious damage by the earthquake occurred in the region of Bais, Tanjay, Bayuan (Tolong), and Siaton, where the surface rocks are unconsolidated sedimentaries, a mixture of sand, clay, and gravel. In Dumaguete and Bacong, where the surface rocks consist in the main of volcanic extrusives, little or no damage occurred, although the earthquake was undoubtedly felt with equal intensity.

ILLUSTRATIONS

PLATE 1

FIG. 1. Tanjay church after the earthquake.
2. Fissures in the provincial road, 1 kilometer south of Polo Barrio, municipality of Tanjay.

PLATE 2

Map of southern Negros.

1

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PLATE 1.

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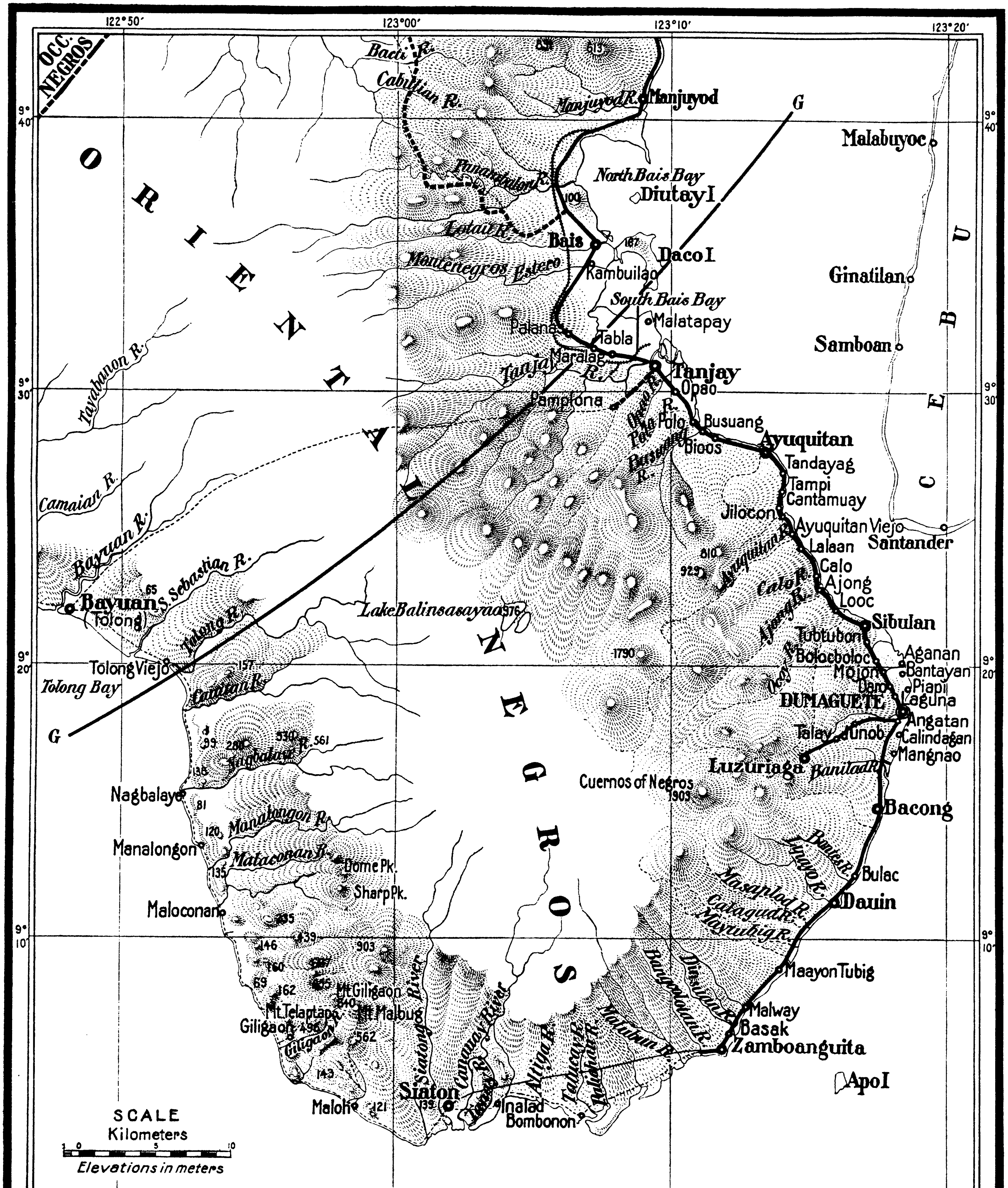

Based on map of Coast & Geodetic Survey. 1927.

PLATE 2. SOUTHERN NEGROS.

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ALCOHOL ADDITION PRODUCTS OF THE BROMO DERIVATIVE OF MIXED ETHERS AND BROMO DERIVATIVE OF DIPHENYL-ISOPROPYL ETHER

By D. M. BIROSEL

Chemist, Bureau of Science, Manila

Several studies have appeared in the chemical literature on the action of methyl and ethyl alcohols upon the bromo derivatives of propenyl compounds in which the carbon atom of the side chain is directly attached to the benzene nucleus, such as the bromo derivatives of anethol, isosafrol, and isoapiol and analogous compounds. It has been found that, when they are boiled with alcohols, they are converted into compounds containing a lower percentage of bromine than is contained in the starting material.

Hell and Gunthert[1] found that anethol dibromide is changed into a product containing less bromine, which they designated as *p*-α-bromo-*p*-ethoxypropyl anisole. Ciamician and Silber[2] found that monobromisosafrol is changed by boiling with ethyl alcohol. Hell and Hoering[3] stated that a noncharacteristic oil is formed when monobromisosafrol dibromide is boiled with ethyl alcohol. Pond and Shoffatall[4] converted anisilidine acetophenone dibromide into methyl or ethyl addition products when they boiled it with either methyl or ethyl alcohol. Orndorff and Morton[5] prepared an alcohol addition product of anethol by causing a slight excess of alcoholic potash to react with anethol hydrochloride. Strauss[6] reported having obtained 1,4-diphenyl-1,2-dimethoxy-3-butene by boiling diphenyl butadiene dibromide with methyl alcohol. Pond, Erb, and Ford[7] prepared the methyl and ethyl addition products of monobrom anethol by boiling anethol dibromide with the corresponding alcohol represented as follows:

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[1] Journ. Prakt. Chem. 52: 199.

[2] Berichte 23: 1164.

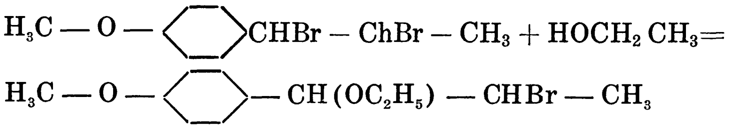
[3] Inorg. Diss. (Roslock) (1897) 59.

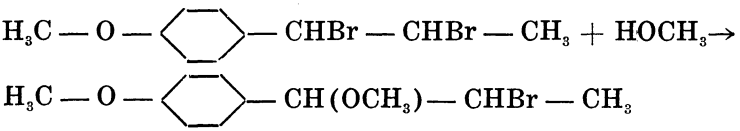
[4] Journ. Am. Chem. Soc. 22 (1900) 668–670.

[5] Journ. Am. Chem. Soc. 23 (1900) 181.

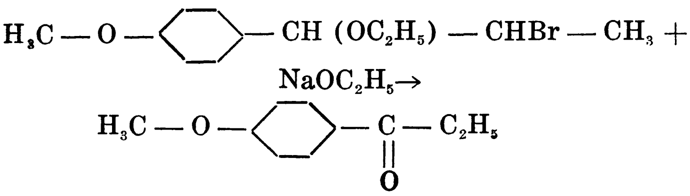
[6] Berichte 42 (1909) 2866.

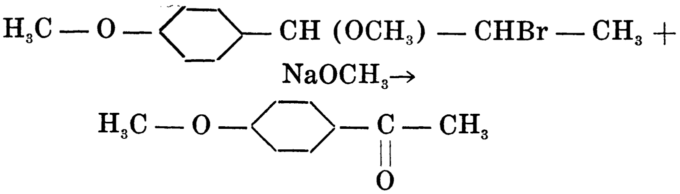
[7] Journ. Am. Chem. Soc. 24 (1902) 329.

(1)

H3C — O — CHBr – ChBr – CH3 + HOCH2 CH3=
H3C — O — CH (OC2H5) — CHBr — CH3

(2)

H3C — O — CHBr — CHBr — CH3 + HOCH3→
H3C — O — CH (OCH3)— CHBr — CH3

They converted these products into anisyl ethyl ketone and anisyl methyl ketone by treatment with either sodium ethoxide or sodium methoxide represented as follows:

(1)


(2)


Also, when the alcohol addition products of monobrom anethol are treated with alcoholic potash, the corresponding keto compounds are obtained. Pond and Wallach[8] likewise obtained these ketones by treating the dibromide with two molecular proportions of either sodium ethoxide or sodium methoxide. Hell and Hallenberg[9] also obtained these ketones. These keto bodies proved that the alkoxy group is attached to the carbon atom attached or nearest to the benzene nucleus which explains the easy formation of these ketones. The work of Tiffenenou and Daufresne[10] showed that the bromine atom nearest the phenyl radical in compounds of the type Ar-CH_2CHBr-CH_2Br can easily be replaced by a substituting group such as the hydroxyl or acetyl or other radicals.

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[8] Berichte **28**: 2718.
[9] Berichte **29**: 688.
[10] Compt. Rend. **144** (1907) 924.

The action of the alcohols on the bromo derivatives of mixed ethers has not been studied. Fairbourne and Toms [11] reported 2,4-dinitrophenyl β,γ-dibrompropyl ether, but they have not studied the effect of methyl or ethyl alcohol on their compound. Raiford and Colbert [12] repeated Fairbourne's work and obtained the same result, but did not try the action of alcohols on their compound. Claisen [13] and his students studied extensively phenyl allyl ether and its isomeric compound allylphenol, but their numerous papers contain nothing on the subject under consideration.

No work is on record which treats of the action of the alcohols upon the bromo derivatives of alkylene compounds in which the alkyl group is not directly attached to the benzene nucleus, such as the bromo derivatives of phenyl-allyl ether, phenyl-butylene ether, etc.

While working in Raiford's laboratory [14] I found that, when the bromo derivative of phenyl allyl ether and the bromo derivative of allylphenol are treated with absolute alcohol, compounds poorer in bromine content are obtained. When 4,6-dibromphenyl-β,γ-dibrompropyl ether was treated with absolute ethyl alcohol, a compound was obtained in which both of the bromine atoms on the alkyl group were replaced by two ethoxy radicals; 4,6-dibromphenyl-β,γ-diethoxypropyl ether was obtained. Only one atom of bromine in the alkyl radical was substituted in the case of 2-(β,γ-dibrompropyl)-4,6-dibromphenol when the compound was treated with absolute ethyl alcohol; 2-(β-ethoxy-γ-monobrompropyl)-4,6-dibromphenol was prepared. It was also found that absolute methyl alcohol gives analogous reaction.

So far as I am aware, no work of this nature has been reported in the chemical literature which treats of the action of the alcohols upon the bromo derivatives of phenylisoalkyl ethers. Raiford and Birosel [15] have not extended their work upon this group of compounds. The present study was undertaken with the view to find out whether this effect of the alcohols upon the bromo derivatives of phenylallyl ether is a general reaction and to extend further the study of these mixed ethers.

The behavior of mixed ethers in which the alipathic radical contains a secondary or a tertiary carbon atom has received very little attention. Some of these compounds have been synthesized, but the action of bromine on them has not been reported.

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[11] Journ. Chem. Soc. 119 (1921) 1038.

[12] Journ. Am. Chem. Soc. 48 (1926) 2652–2662.

[13] Berichte 45 (1912) 3157; Ann. 401 (1913) 21; 418 (1919) 69.

[14] Birosel, Dissertation, Iowa (1926).

[15] Dissertation, Iowa (1926).

Hautzsch and Vock,[16] following the method of Remsen,[17] obtained phenyl isopropyl ether when they treated diazonium chloride with ten times the theoretical amount of secondary alcohol. Riess[18] reported having obtained phenyl-isobutyl ether when he digested together equivalent amounts of phenol, isobutyl bromide, and potassium hydroxide in alcoholic solution. Bamberger[19] also obtained phenyl-isobutyl ether by digesting phenol, isobutyl iodide, and alcoholic solution of potassium hydroxide. Orndorff and Hopkins obtained phenyl isoamyl ether by Remsen's method, which calls for the decomposition of diazonium chloride by isoamyl alcohol and the formation of the ether.

In their work with the mixed ethers, Raiford and Birosel found that the modified Claisen's method was applicable in the synthesis of the phenylisoalkyl ethers. Claisen recommended that a half mole each of the alkyl halide, phenol, and potassium carbonate be digested in 100 cubic centimeters of acetone in a 500-cubic-centimeter flask fitted with a reflux condenser in eight hours over a water bath. Raiford and Birosel recommend that, instead of a monomolecular proportion, a little excess of the alkyl halide and potassium carbonate and the same weight of acetone as that of phenol should be used and digested with a reflux condenser at the boiling point of the acetone. This they found to work better. By this method they synthesized phenyl isoalkyl, 2,4-dibrom phenyl isopropyl, and 2,4,6-tribromphenyl-isopropyl ethers. Starting with these three compounds they obtained 2,4,6-tribromphenyl-β-monobromisopropyl ether by direct bromination in chloroform solution.

A review of the literature will show that the halogen atom attached to the benzene ring is not affected by boiling the substance with alcoholic solution of potassium hydroxide. The work of Hell and Gunthert on monobromanethol dibromide, the work of Ciamician and Silber[20] on monobromisosafrol dibromide, and the work of Raiford and Birosel on 2,4-dibromphenyl-β,γ-dibrompropyl ether and 2-(β,γ-dibrompropyl)-2,4-dibromphenol, etc., show that only the halogen atom on the alkyl is affected by alcoholic solution of potassium hydroxide.

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[16] Berichte **36** (1903) 2061.

[17] Journ. Am. Chem. Soc. **11**: 291.

[18] Berichte **3** (1886) 780.

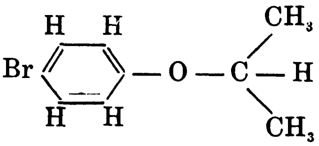
[19] Berichte **19** (1886) 1820.

[20] Berichte **23**: 1164.

It is expected therefore that the alkoxy group attaches itself to the carbon where the halogen atom formerly attached itself. In the case of 2,4,6-tribromphenyl-β-monobromisopropyl ether, only the β-bromine atom is replaceable by the alkoxy group. Hence, when this bromo compound is treated with ethyl alcohol 2,4,6-tribromphenyl-β-ethoxyisopropyl ether is the compound prepared.

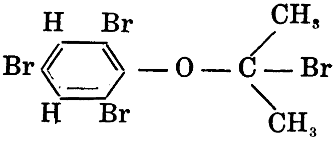
EXPERIMENTAL

p-Bromphenyl isopropyl ether,



By starting with *p*-bromphenol, I prepared *p*-bromphenyl isopropyl ether.[21] Twenty-four grams of *p*-bromphenol were digested with 5 per cent excess of the theoretical amount of isopropyl iodide, potassium carbonate, and 24 grams of acetone for several hours at the boiling temperature of acetone. After digestion, the reaction flask was cooled, an equal volume of water and ether added, and the mixture shaken vigorously. The ethereal solution was separated by means of a separatory funnel and shaken vigorously with excess 10 per cent sodium hydroxide solution to remove unchanged *p*-bromphenol. The ether solution was separated and dried with potassium carbonate. The petroleum ether solution was filtered and the solvent distilled off. The residue distilled over at 155 to 165.22° millimeters. It boiled at 236°, hence the compound must be the same as the *p*-bromphenyl-isopropyl ether which was reported by Silva.[22]

2,4,6-Tribromphenyl-β-monobromisopropyl ether,



Thirty-five grams of the *p*-bromphenyl isopropyl ether were dissolved in chloroform. A great excess of bromine solution in chloroform was slowly added while the ether solution was being stirred vigorously. The solution became hot on addition of the bromine solution and it was sometimes necessary to cool the reaction flask in ice water. A cloud of hydrobromic acid was given off on each addition of bromine solution. The reaction flask was laid aside for three days under the hood to complete the reaction. After that time the solvent was distilled off, the excess bromine also going off with it.

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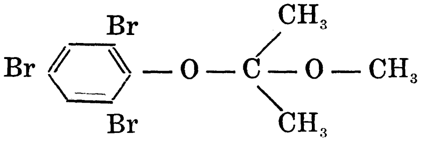
[21] This synthesis was undertaken in the University of Iowa after I had submitted my dissertation to the Graduate School.

[22] Zeitschrift für Chemie (1870) 250.

The needle crystal obtained was recrystallized several times from petroleum ether and a perfect white needle crystal melting point with the compound prepared by Raiford and Birosel gave 93° C. This compound is no doubt the same as the 2,4,6-tribromphenyl-β-monobromisopropyl ether obtained by them. Analysis for the bromine content of the compound gave the following figures:

	Carius.		Modified Meulen.[23]	
	A	B	A	B
Weight of substance used	0.1477	.1322		
Weight of AgBr	0.2460	0.2195		
Found, per cent	70.81	70.75	70.65	
Calculated from $C_9H_8O\,Br_4$, per cent		70.78		

2,4,6-Tribromphenyl-β-methoxyisopropyl ether,[23]



Ten grams of the above compound were digested with excess methyl alcohol in a 200-cubic-centimeter Erlenmeyer flask fitted with an air condenser. Silver nitrate was added. Silver bromide was deposited at the bottom of the flask. Digestion was continued for several hours. The excess alcohol was distilled off and then equal volumes of water and petroleum ether were added. The ethereal solution was separated and washed several times with water to eliminate alcohol entirely from the product. The solvent was distilled off and the residue put under vacuum for a long time to remove the solvent completely. A brown reddish viscous liquid was obtained. This was left several days on the table and a crystal was formed which melted at 118 to 120° C.

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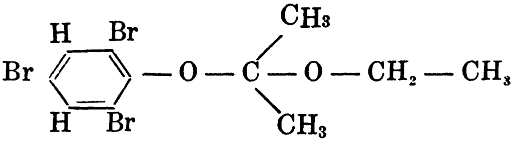
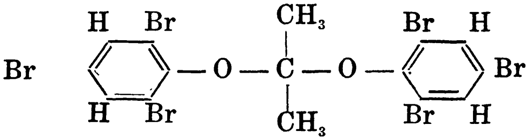
[23] This modified Meulen's method of analysis of halogen by combustion is due to the work of F. L. Smith, Philip. Journ. Sci. 32 (1927) 315. The figure obtained by this method checks favorably with those obtained by the Carius method and with the calculated figure. This method under an expert analyst has the advantage over the Carius method that it consumes less time. Thanks are due to Miss Irene Santos, assistant in chemistry, University of the Philippines, who kindly undertook this check analysis. The figures under Carius were obtained after I had undertaken about fifty analyses on the bromo derivatives of mixed ethers in the laboratory of Dr. C. L. Raiford, State University of Iowa.

2,4,6-Tribromphenyl-β-ethoxyisopropyl ether,[24]



Ten grams of 2,4,6-tribromphenyl-β-monobromisopropyl ether were digested as above with absolute ethyl alcohol for several hours. The 200-cubic-centimeter flask was cooled and equal volumes of water and petroleum ether were added and the mixture was shaken vigorously. The petroleum ether solution was separated and was washed several times with water, to remove excess of ethyl alcohol. The petroleum ether solvent was distilled off and the residue subjected to pressure for several hours. A brown reddish viscous liquid was obtained which, when laid aside for several days, gave crystals which melted at 130 to 132° C. This compound is soluble in most organic solvents and to some extent in water. Hydrolysis with sulphuric acid and testing the steam distillate for ethyl alcohol produced a positive iodoform text. The product obtained by the action of ethyl alcohol on 2,4,6-tribromphenyl-β-monobromisopropyl ether is 2,4,6-tribromphenyl-β-ethoxyisopropyl ether, and when methyl alcohol is used, 2,4,6-tribromphenyl-β-methoxyisopropyl ether is produced.

β(-2,4,6-Tribromphenyl)-β(-2,4,6-tribromphenyl)-isopropyl ether,



Six grams of phenol were treated with less than the required amount of 2,4,6-tribromphenyl-β-monobromisopropyl ether for a monomolecular proportion. Excess potassium carbonate was added to the acetone solution; the amount of solvent used was equal to the weight of the phenol. The mixture was digested for several hours at the boiling temperature of acetone. When the mixture was cool, equal volumes of water and petroleum ether were added and the mixture was shaken vigorously. Three layers were obtained; namely, aqueous, petroleum, and oil. The oil was separated and dried. It solidified and was dissolved in petroleum ether. It recrystallized in fibrous crystals. It melted at 125 to 130° C. and decomposed at over 140° C. The compound[25] gives a black residue when burned. It does not dissolve readily in chloroform but when bromine solution in the same solvent is added it dissolves readily, giving potassium bromide precipitate which collects at the bottom of the flask, and at the same time hydrogen bromide is also given off. The solution is laid aside for three days to complete the reaction, and at the end of this time the precipitate is filtered and the solvent and excess bromine are distilled off. Recrystallization of the solid residue from petroleum ether yields white needle crystals which melt at 86.5° C. A mixed melting point with 2,4,6-tribromphenylmonobromisopropyl ether was taken and 88° C. was read. Analysis for bromine content shows the following figures:

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[24] The material here used was brought from the United States. These experiments were undertaken in the organic laboratory of the Bureau of Science.

0.0513 gram of substance gave 0.0823 gram of dry AgBr.
0.0511 gram of substance gave 0.0821 gram of dry AgBr.

	Per cent.
Found	68.37 and 68.27
Calculated from $C_{15}H_{10}O_2Br$,	68.35

SUMMARY

1. The effect of the alcohols encountered by various workers upon the bromo derivatives of propenyl compounds in which the side chain is directly attached to the benzene ring is found to be a general reaction upon the bromo derivatives of *n*-alkyl compounds; it is also applicable in compounds in which the side chain is connected with an oxygen atom attached directly to the benzene nucleus.
2. The compound 2,4,6-tribromphenyl-β-monobromisopropyl ether was prepared by direct bromination in chloroform solution of *p*-bromphenyl isopropyl ether.
3. Alcohol addition products, 2,4,6-tribromphenyl-β-methoxyisopropyl ether and 2,4,6-tribromphenyl-β-ethoxyisopropyl ether were prepared from 2,4,6-tribromphenyl-β-monobromisopropyl ether.
4. Also, β(-2,4,6-tribromphenyl)-β(2,4,6-tribromphenyl)-isopropyl ether was prepared.
5. A brief review of the literature upon the subject is given.

ACKNOWLEDGMENT

I take this opportunity to thank my former research instructor, Dr. C. L. Raiford, whose interest in my work under him aroused my interest in this study.

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[25] It is hoped that this intermediate compound will be studied further to establish its structure, when the necessary chemical is available in the laboratory.

LIFE TABLES FOR THE NATIVE RESIDENT POPULATION OF THE CITY OF MANILA FOR THE YEAR 1920

By EUGENIO HERNANDO

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SIX TEXT FIGURES

DESCRIPTIVE

The City of Manila is the capital of the Philippine Islands. It is situated on Manila Bay at the mouth of Pasig River, and occupies an area of 36 square kilometers of lowlands. Pasig River runs through the city, dividing it into two parts. The oldest part lies to the north of the river and is inhabited by the Chinese and other laboring classes of the city. This district is not so well improved as is that located to the south of the river, which is almost exclusively residential in character and is inhabited by the well-to-do Filipino and the white population of the city. Only about one-third of the area of the City of Manila is provided with sanitary sewerage. The pail system is used in the area without sewerage, and in this area there are about three hundred public closets.

Manila has two principal sources of drinking water; namely, the Metropolitan Water District supply (surface water) and thirty-five artesian wells scattered throughout the city.

The surface water is taken from Montalban River, which is protected by restriction of the water shed. During the dry season, water is taken also from Mariquina River. The water from these rivers is stored in reservoirs; that from the Montalban in a modern, open, 55,000,000-gallon basin and that from the Mariquina in an old covered reservoir of 19,000,000 gallons capacity. It is estimated that the daily consumption of water in the City of Manila is about 23,000,000 gallons, of which artesian wells furnish about 170,000 gallons.

City water is treated raw by calcium hypochlorite at the rate of from 0.05 to 0.06 part available chlorine per million parts of water, depending upon the degree of turbidity of the water. This is the only treatment received by the water before it reaches the public.

The mean annual temperatures of the city are 21.9° C. minimum and 31.1° C. maximum. The average relative humidity is 79.5 per cent. There are two seasons during the year; namely, the rainy season, which begins in May and lasts until the middle of November, and the dry season, which prevails during the remaining months of the year. Each year during the rainy season some portions of the city are flooded.

The sanitary organization of the City of Manila is satisfactory enough, though the financial condition of the Municipal Government does not permit of permanent sanitary improvements or the sanitary engineering projects that such a large city needs; nevertheless, the general sanitary condition can be said to be fair.

STATISTICAL DATA

The population of the City of Manila is 283,613 distributed as shown in Table 1.[1]

TABLE 1.—*Population of the City of Manila by nationalities.*

Americans	3,134
Filipinos, including residents and transients	257,356
Spaniards	1,955
Other Europeans	1,126
Chinese	17,856
All others	2,186
Total	283,613

The native (Filipino) resident population was used for the construction of these life tables. By native population is meant all persons born in the Philippines of Filipino parents and those born of natives married to foreigners. The people born in the Philippines of foreign parents (both mother and father) were excluded from the native population. All natives who had resided in the city for more than one year were also considered to be residents. People from the provinces who had resided less than one year in the city were excluded.

These life tables were constructed as of July 1, 1920. The population at this time was calculated arithmetically, by taking as bases the populations given in the official census made in the years 1903 and 1918. Thus the population estimated as native and resident of the City of Manila on July 1, 1920, was 140,871 males and 130,450 females.

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[1] Census of the Philippine Islands 2 (1918).

The basic figures of mortality data were the number of deaths reported for the years 1919, 1920, and 1921, in which years no epidemic or other special causes of death were registered which might affect the normal mortality of the city.

The mathematical process followed in the preparation of these life tables was that taught by Dr. Lowell T. Reed, of the Johns Hopkins School of Hygiene and Public Health.

Three life tables have been prepared; namely, one for males, one for females, and one for both sexes.

The expectation of life calculated for the native-born population of the City of Manila is compared with the expectation of life of Filipinos, Chinese, Japanese, and Hawaiians in Hawaii in 1920, and also with that of the colored population in the original Registration States in the United States in 1910.

Partial tables are also included in this paper for the purpose of comparing the values of qx (rate of mortality per thousand), lx (survivors) and $\mathring{e}$x (expectation of life) of the racial classes mentioned in the preceding paragraph, the life table for both sexes having been selected for this purpose.

The values of qx, lx, and $\mathring{e}$x pertaining to the Filipinos, Chinese, Japanese, and Hawaiians in Hawaii were taken from an article entitled Life tables for various racial groups in Hawaii[2] and the same values for the colored population, from the United States life tables.[3]

The Manila life tables of 1920 are not compared with the life tables of the colored population of the United States for the same year because a copy of the United States life tables of 1920 was not available.

The life tables for the native-born population of the City of Manila are compared with the life tables of Hawaii, because it is the only country in the world outside of the Philippines in which there is an organized Filipino colony of any size. From the last census of the Hawaiian Islands, the Filipino population in Hawaii in the year 1920 was 16,851 males and 4,180 females. As the climate of Hawaii is subtropical rather than tropical as in the Philippines, objection might be made to a comparison of the life tables for these two countries; but the differences in climate between Hawaii and the Philippines are too slight to invalidate such comparison.

[2] Hsien W. Kung, Am. Journ. Hyg. 6 (January, 1926).

[3] Bureau of Census, Washington, D. C. (1910).

On the other hand, the sanitary conditions in Hawaii are, according to available information, much better than those in the Philippines and especially those in the City of Manila. This being so, it is pertinent to inquire whether or not Filipinos increase their expectation of life when living under better sanitary conditions than they do at present in Manila.

UNAVOIDABLE ERRORS IN THE CONSTRUCTION OF THE LIFE TABLES

Before entering into the discussion of these life tables, it is necessary to point out some unavoidable errors in their preparation, in order that these may be taken into consideration in evaluating the results, although such errors are not of sufficient importance to alter the conclusions essentially.

The first error to be considered is that committed in the estimates of population as of July 1, 1920. No census was taken in 1920 and for this reason the population of the year 1920 was estimated by arithmetical computations, taking as bases the populations of the Census for the years 1903 and 1918.

The census taken in 1903 cannot be considered accurate, because at that time the Filipino Insurrection was so recent that the people, doubting the object of the census, did not coöperate and, as a consequence, a portion of the population was concealed and not enumerated. This fact conceded, it is evident that the population given in the Census for the year 1903 was entirely too low. In the Census for the year 1918 the population was much better enumerated, but this census coincided with the influenza pandemic which caused an increase in mortality for that year. However, despite these sources of error, it is believed that, in so far as the City of Manila is concerned, they are not of such magnitude as to alter substantially the final results.

The second unavoidable error is the distribution of population by age groups and the mortality registered in each group. The return by ages cannot be considered absolutely accurate because of a small proportion of illiterate people who were unable to furnish correct statements of their ages. This condition obtained in only about 5 per cent of the population of the city and this small number should not appreciably affect the values obtained.

DISCUSSION OF THE LIFE TABLES

Mortality.—Studying the values of qx in the life table constructed for the native-born population of the City of Manila, one is first impressed with the high infant mortality and the fact that infant mortality is higher in males than in females. In fact, infant mortality for males is 275.02 against 192.55 for females. The mortality is higher also in males than in females in the groups of ages following the group 0–1 up to the group 26–27 when the mortality among females exceeds that among males. Beginning with the group of ages 52–53, the mortality among males is again higher than in females and this difference becomes greater and greater as age increases.

These results differ in certain particulars from those observed in other communities. It is true that in any community mortality is higher for males than for females during infancy and vice versa during puberty; but in old age, or after reaching the age of 50 years, although the difference is unfavorable to the males, this difference is not so pronounced as is the case for the native-born population of the City of Manila. This difference can be better observed by consulting fig. 1.

Table 2 has been prepared for the purpose of comparing the values of qx of the native-born population of the City of Manila with the same values for the Filipinos, Chinese, Japanese, and Hawaiian population of Hawaii and the colored population of the United States.

TABLE 2.—*Values of qx (mortality per 1,000).*

Population.	Age in years.									
	0–1	10	20	30	40	50	60	70	80	90
Filipinos in Manila, both sexes, 1920	215.38	6.04	8.74	13.06	16.79	23.06	40.13	84.55	186.90	400.49
Filipinos, in Hawaii, both sexes, 1920	263.65	3.68	9.88	11.47	13.70	18.31	30.84	62.07	131.43	272.42
Japanese	93.90	2.48	8.12	9.15	10.28	13.71	24.11	44.04	114.12	278.68
Chinese	89.09	2.71	6.93	9.73	10.90	13.12	23.05	54.38	132.71	303.09
Hawaiians	203.96	9.05	22.56	26.15	30.44	38.18	55.96	96.47	182.33	352.23
Colored people in United States in 1910:										
Males	219.35	5.02	11.96	14.96	21.03	31.42	50.79	83.98	131.27	201.01
Females	185.07	5.18	10.74	12.02	17.50	25.52	45.58	71.27	119.68	172.34

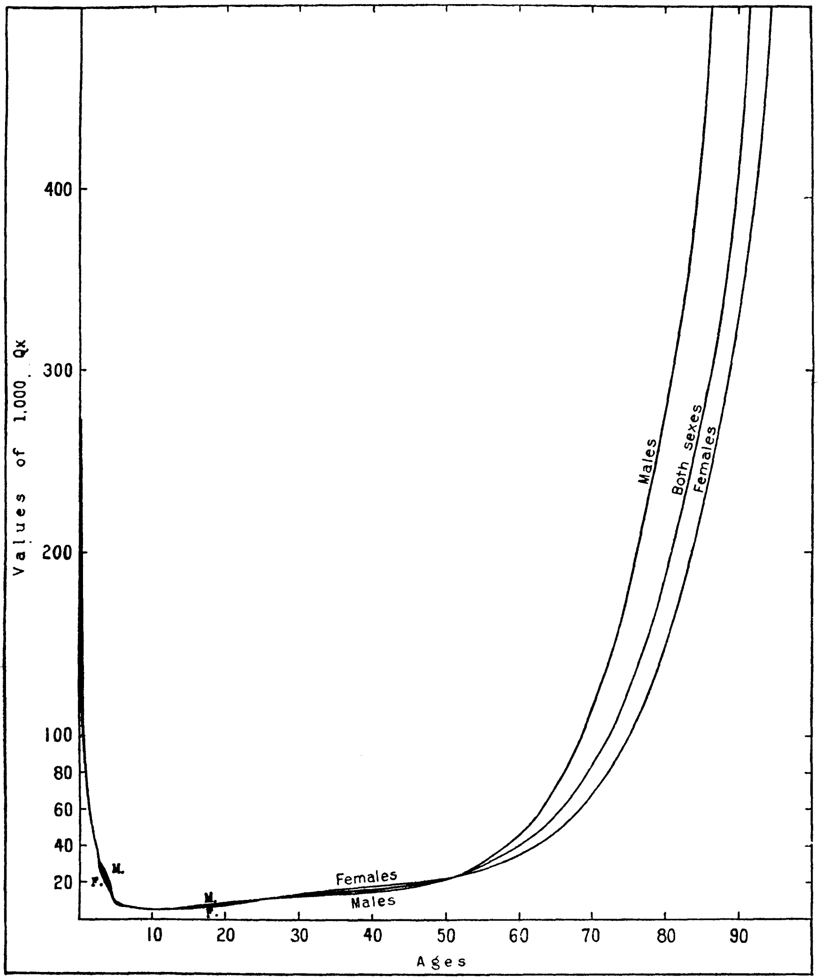

FIG. 1. Diagram of life table for native born in the City of Manila for 1920. Rate of mortality at age X.

The first fact to be noted in Table 2 is that the infant mortality among the native-born population of the City of Manila and among Filipinos in Hawaii exceeded that among Chinese, Japanese, and Hawaiians in Hawaii, and the colored population in the United States. Infant mortality is higher among Filipinos in Hawaii than among Filipinos in Manila.

Kung, referring to the high infant mortality of Filipinos in Hawaii,[4] said:

[4] Hsien W. Kung, Am. Journ. Hyg. 6 (January, 1926).

> This extremely high infant mortality among the Filipinos is in all probability due to the peculiar racial characteristics and to their low social status, the majority of them belonging to the lower laboring classes.

If this be the case in Hawaii, how is the higher infant mortality among the native-born Filipinos in the City of Manila to be explained?

We know that, since 1920, infant mortality in the Philippine Islands, and especially in the City of Manila, decreased appreciably owing to extensive prenatal and postnatal education among expectant mothers. Taking this fact into consideration, the only explanation for the high infant mortality prior to 1920 is that it was due to the peculiar social rather than racial characteristics of mothers, the characteristics of improper feeding and care of babies and of subjecting them to insanitary surroundings.

The mortality figures in the other age groups are higher for the native-born population of the City of Manila than for the Filipinos, Chinese, and Japanese in Hawaii. The differences between the native-born population of Manila and the colored people in the United States are not significant, but the inflection of the curve for colored people in the United States is less pronounced.

Mortality in the native-born population of the City of Manila is lower than in the Hawaiian population up to the age group 70–80. From this age group on, mortality in Manila is greater than in any of the other racial groups. This is against the alleged longevity of Filipinos. (See fig. 4.)

Survivors.—Figure 2 shows the curve of the survivors at all ages for the native-born population of the City of Manila. Examination of this figure and of the lx values in Table 3, reveals that the hypothetical population of 100,000 males has dwindled to one-half at the age of 27 years, but in females such reduction is reached ten years later; the 100,000 male population disappears at the age of 93 and the female at the age of 101.

Table 3 and fig. 5 have been prepared for the purpose of comparison of the lx values of the native-born population of the City of Manila with the corresponding values for Filipinos, Chinese, Japanese, and Hawaiians in Hawaii and colored people in the United States.

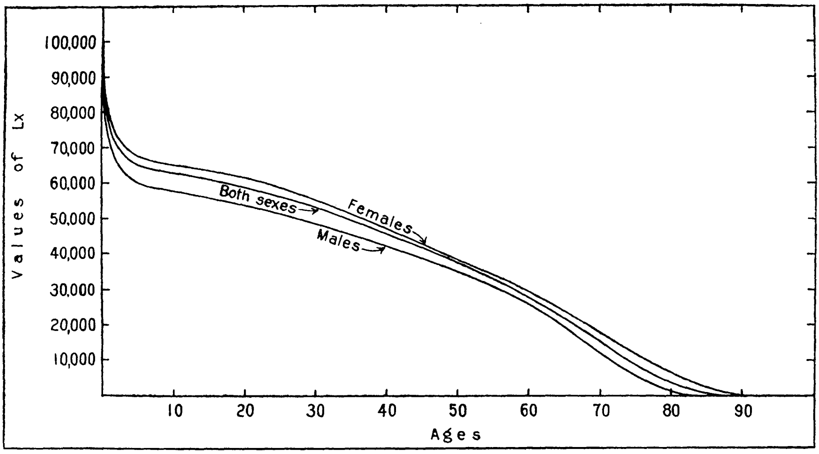

FIG. 2. Diagram of life table for native born in the City of Manila for 1920. Number of survivors at age X.

TABLE 3.—*Values of lx (survivors).*

Population.	Age in years.				
	10	20	30	40	50
Filipinos in Manila, both sexes, 1920	62,900	58,805	52,887	45,593	37,575
Filipinos in Hawaii, both sexes, in 1920	64,822	60,887	54,758	48,329	41,378
Japanese in Hawaii, both sexes, in 1920	84,678	80,812	74,109	67,304	59,962
Chinese in Hawaii, both sexes, in 1920	83,917	82,485	75,837	68,363	60,822
Hawaiians in Hawaii, both sexes, in 1920	67,132	57,588	45,103	33,965	24,175
Colored people in United States in 1910:					
Males	66,377	61,426	54,073	45,414	35,427
Females	70,508	64,764	58,281	50,368	40,886

Population.	Age in years.				
	60	70	80	90	100
Filipinos in Manila, both sexes, 1920	27,899	15,522	4,106	169	0
Filipinos in Hawaii, both sexes, in 1920	32,802	21,190	8,324	1,038	8
Japanese in Hawaii, both sexes, in 1920	50,237	36,730	17,826	2,458	13
Chinese in Hawaii, both sexes, in 1920	51,485	36,208	14,975	1,596	4
Hawaiians in Hawaii, both sexes, in 1920	15,263	7,258	1,795	100	0
Colored people in United States in 1910:					
Males	23,750	12,295	3,894	595	40
Females	28,908	15,871	6,324	1,206	112

In this study the survivors' curve in Manila falls below the survivors' curve for Filipinos in Hawaii, and both curves run above the survivors' curve for Hawaiians except for the age group 0–1. This exception is due to the high infant mortality registered among Filipinos.

Also, it will be observed that the number of survivors among the colored people in the United States is greater than that among the Filipinos in Manila, although both lines coincide in the 50-to-70 age group. Up to the age of 40 the Filipino survivors in Hawaii are more numerous than are those in Manila or than in the colored population of the United States. The curve for the survivors among the Filipinos in Manila shows a more uniform and regular decline than does that of the Hawaiians.

Another feature observed is that the hypothetical population (both sexes) was reduced to one-half at the age of 34 years in the native-born population of the City of Manila, while this reduction was reached at the age of 37 years among the Filipinos in Hawaii, at 60 among Japanese, at 61 among Chinese, at 26 among Hawaiians, at 35 among colored males, and at 41 among colored females.

The total extinction of the hypothetical population (both sexes) occurred at the age of 98 among the native-born population in Manila, at the age of 104 among the Filipinos, Japanese, and Chinese in Hawaii, at 99 among Hawaiians, at 109 among colored males, and at 110 among females.

Expectation of life.—Tables 5, 6, and 7 and fig. 3 show the expectation of life for the native-born population of the City

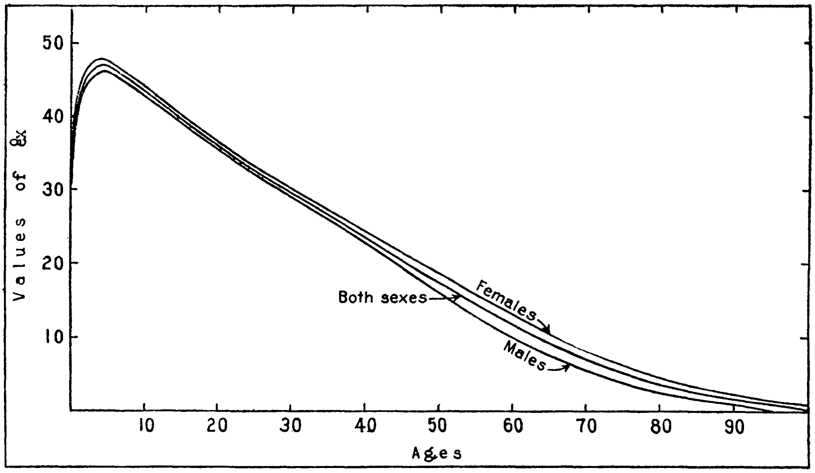

FIG. 3. Diagram of life table for native born in the City of Manila for 1920. Expectation of life at age X.

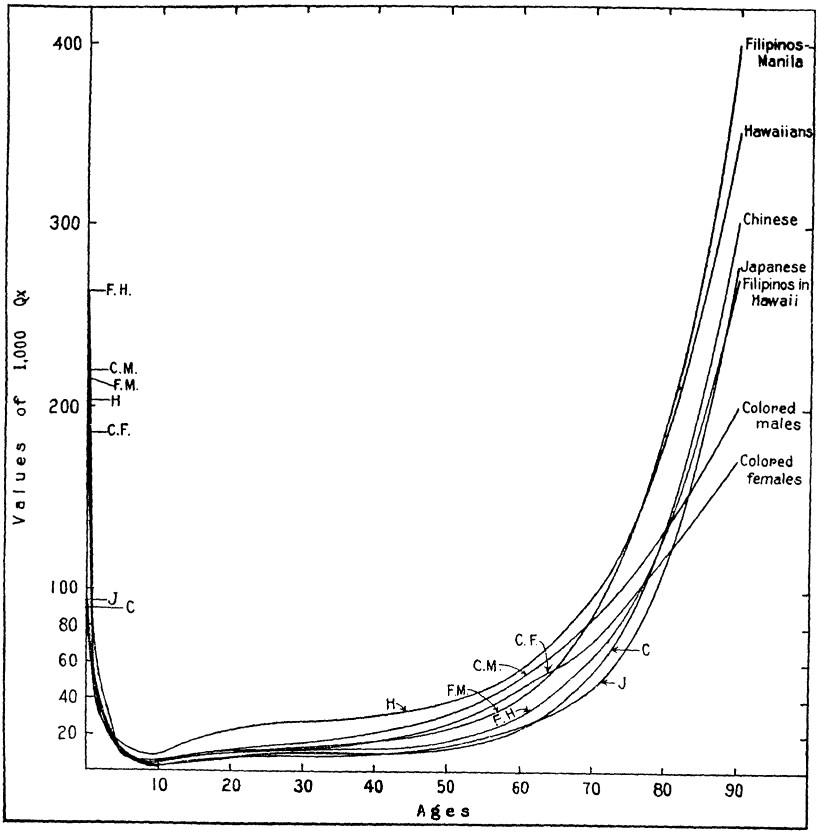

FIG. 4. Diagram of life tables for native born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii (both sexes) for 1920, and colored people (males and females) in the original registration states for 1910. Rate of mortality at age X.

of Manila for the year 1920. Table 8 and fig. 6 have been prepared for the purpose of comparison of the expectation of life of the native-born population of the City of Manila with that of the other populations considered in this paper.

The $\overset{\circ}{e}x$ values depending upon the qx and lx values, it is unnecessary to comment at length on the tables and charts mentioned. The first fact observed is that, as is the case in other countries, the expectation of life at all ages is higher among females than among males. Also, the expectation of life among the native-born population in the City of Manila is less at all ages than that of the Filipinos, Japanese, and Chinese in Hawaii; is greater than that of the Hawaiians; and approximates that of the colored population of the United States in 1910. The expectation of life of the colored population in the United States was somewhat greater in 1920 than in 1910, so that the expectation of life of the native-born population of the City of Manila in 1920 was less than that of the colored population of the United States in the same year.

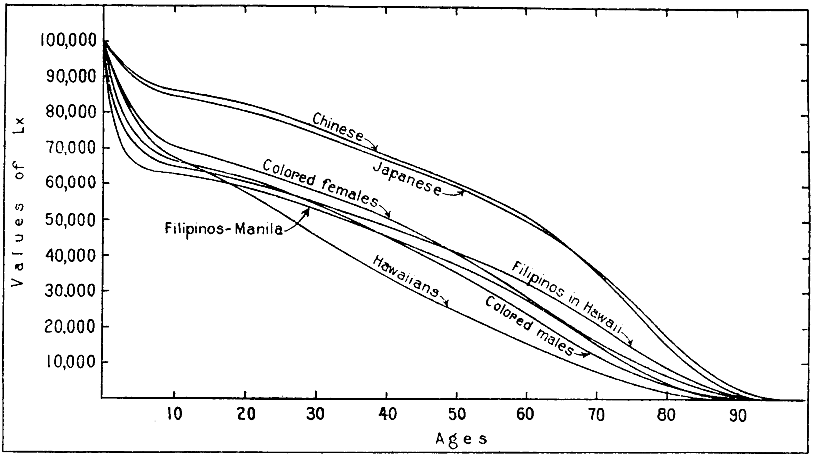

FIG. 5. Diagram of life tables for native born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii (both sexes) for 1920, and colored people (males and females) in the original registration states for 1910. Number of survivors at age X.

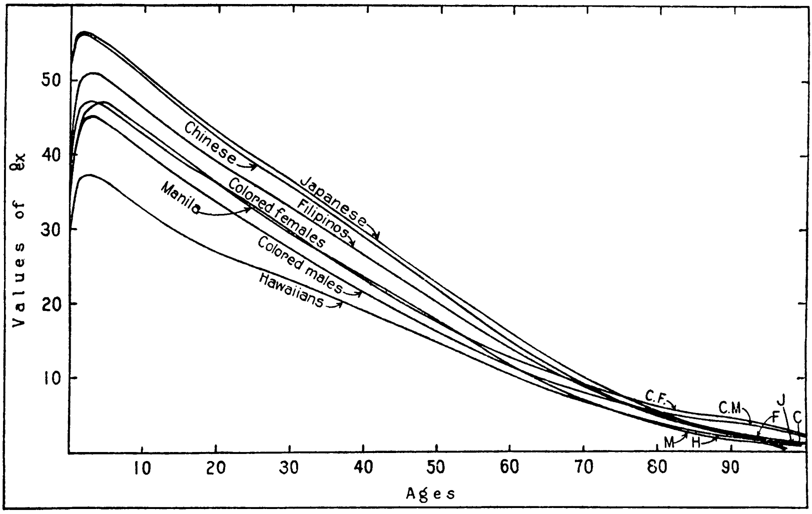

FIG. 6. Diagram of life tables for native born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii (both sexes) for 1920, and colored people (males and females) in the original registration states for 1910. Expectation of life at age X.

CONCLUSIONS

It is a fact that the expectation of life in a community, at least in the 0-to-40 age groups, increases in proportion to the sanitary improvements in that community. As a proof of this affirmation Table 4, showing the expectation of life for the white and the colored populations of the original Registration States in 1901, 1910, and 1920, is here presented. It is generally known that the major sanitary advances made in some parts of the United States were instituted after the year 1910.

TABLE 4.—*Expectation of life in the original Registration States, United States.*

	Year.	Age in years.		
		0	32	62
White males	1901	48.2	33.4	13.2
	1910	50.2	33.3	12.9
	1920	54.0	34.9	13.4
White females	1901	51.1	35.0	14.0
	1910	53.6	35.4	13.7
	1920	56.3	36.1	14.0
Colored males	1901	32.5	28.0	11.7
	1910	34.0	26.2	10.9
	1920	40.1	28.5	11.4
Colored females	1901	35.0	29.4	12.7
	1910	37.7	28.3	12.0
	1920	43.2	28.8	12.1

From this biometrical study of the native-born population of the City of Manila the following conclusions can be formulated:

1. That the expectation of life of the native-born population of the City of Manila is less at all ages than that of Filipinos, Japanese, and Chinese in Hawaii; equal to that of the colored population in the United States in the year 1910; and greater than that of the Hawaiians.

2. That the native population of the City of Manila, being constituted of various widely different social classes, while the Filipino population in Hawaii is for the most part imported for plantation work and other manual labor, should have, all other factors being equal, a greater expectation of life than the Filipinos in Hawaii.

3. The fact that the Filipinos in Hawaii enjoy a greater expectation of life than do their brethren in Manila, despite the

fact that, as a class, they are engaged in much harder labor, is probably due to the better sanitary environment in which they live.

4. If the expectation of life of the native-born population of the City of Manila be compared with that of the colored population in the United States, it might be concluded that the sanitary conditions of the native-born population of the City of Manila in the year 1920 was similar to that of the colored population of the United States in the year 1910, and inferior to that for the year 1920. However, there may be a racial factor involved here.

The notable increase in the expectation of life obtained in the United States, especially in the last fifteen years and in the 0-to-40 age groups, was undoubtedly largely due to the work of the sanitary engineer, and particularly to the purification of water supplies and to sewer and waste disposal. Protection of the food supply and improvement in housing conditions also contributed.

If advantage be taken of the experience of the countries most advanced in sanitary matters, the expectation of life of the native-born population of the City of Manila will be increased when municipal governments install permanent sanitary improvements such as the following:

A safer and more-adequate water supply. The chlorinization by calcium hypochlorite as the sole treatment of raw water is not sufficient to insure a safe water supply. A filtration plant and treatment of the filtered water with liquid chlorine are essential.

The extension of the sanitary sewer to all parts of the city and treatment of the sewage before discharge into Manila Bay.

Replacement of the present types of comfort stations with others of the flush type of closet.

Improvement in the collection and disposal of garbage, rubbish, and other refuse materials.

Improvement of the housing conditions and relief of the overcrowding to which the poor people are now subjected.

Establishment of public parks, especially for the benefit of children.

Filling in of the lowlands and dredging of the esteros.

Efficient sanitary control of food and drinks and correction of the present insanitary conditions in public markets.

An extensive and intensive program of sanitary education in schools, factories, workshops, and homes.

Improvement of the general diet of the population, especially by increasing the consumption of fresh milk by children.

TABLE 5.—*Life table for native-born males (1920) in the City of Manila.*

x to $x + 1$, age interval, period of lifetime between two exact ages.	Of 100,000 males born alive.		1,000 q_x, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}_x$, expectation of life; average length of life remaining to those alive at beginning of age interval.
	l_x, number alive at the beginning of age interval.	d_x, number dying in age interval.		
			Annual rate.	*Age in years.*
0-1	100,000	27,302	273.02	31.16
1-2	72,698	6,344	87.27	41.67
2-3	66,354	3,036	45.76	44.61
3-4	63,318	1,906	30.10	45.72
4-5	61,412	1,440	23.45	46.12
5-6	59,972	476	7.93	46.22
6-7	59,496	441	7.42	45.59
7-8	59,055	416	7.04	44.92
8-9	58,639	397	6.78	44.24
9-10	58,242	386	6.62	43.54
10-11	57,856	379	6.56	42.82
11-12	57,477	379	6.59	42.10
12-13	57,098	381	6.68	41.38
13-14	56,717	388	6.84	40.65
14-15	56,329	397	7.05	39.93
15-16	55,932	408	7.29	39.21
16-17	55,524	420	7.57	38.49
17-18	55,104	434	7.87	37.78
18-19	54,670	448	8.19	37.08
19-20	54,222	461	8.51	36.38
20-21	53,761	470	8.75	35.69
21-22	53,291	489	9.17	35.00
22-23	52,802	505	9.57	34.32
23-24	52,297	520	9.94	33.65
24-25	51,777	532	10.28	32.98
25-26	51,245	542	10.58	32.31
26-27	50,703	581	11.46	31.66
27-28	50,122	592	11.82	31.02
28-29	49,530	602	12.15	30.38
29-30	48,928	609	12.45	29.75
30-31	48,319	616	12.74	29.11
31-32	47,703	621	13.01	28.49
32-33	47,082	624	13.26	27.86
33-34	46,458	627	13.50	27.23
34-35	45,831	629	13.75	26.59
35-36	45,202	631	13.96	25.95
36-37	44,571	632	14.19	25.31
37-38	43,939	634	14.42	24.67
38-39	43,305	635	14.67	24.03

TABLE 5.—*Life table for native-born males (1920) in the City of Manila*—Continued.

x to $x+1$, age interval, period of lifetime between two exact ages.	Of 100,000 males born alive.		1,000 q_x, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}_x$, expectation of life; average length of life remaining to those alive at beginning of age interval.
	l_x, number alive at the beginning of age interval.	d_x, number dying in age interval.		
			Annual rate.	*Age in years.*
39–40	42,670	638	14.95	23.38
40–41	42,032	641	15.25	22.72
41–42	41,391	645	15.58	22.07
42–43	40,746	650	15.96	21.41
43–44	40,096	658	16.40	20,75
44–45	39,438	666	16.90	20.09
45–46	38,772	677	14.47	19.42
46–47	38,095	691	18.14	18.77
47–48	37,404	707	18.90	18.10
48–49	36,697	726	19.78	17.43
49–50	35,971	748	20.80	16.77
50–51	35,223	773	21.96	16.12
51–52	34,450	802	23.28	15.47
52–53	33,648	834	24.79	14.83
53–54	32,814	870	26.50	14.19
54–55	31.944	908	28.44	13.57
55–56	31,036	950	30.62	12.95
56–57	30,086	995	33.08	12.34
57–58	29.091	1,043	35.84	11.77
58–59	28,048	1,092	38.92	11.16
59–60	26,956	1,142	42.36	10.60
60–61	25,814	1,192	46.19	10.04
61–62	24,622	1,242	50.45	9.51
62–63	23,380	1,289	55.15	8.98
63–64	22,091	1,344	60.36	8.48
64–65	20,757	1,371	66.10	8.00
65–66	19,376	1,403	72.43	7.53
66–67	17,973	1,427	79.38	7.07
67–68	16,546	1,439	86.99	6.64
68–69	15,107	1,440	95.34	6.23
69–70	13,667	1,428	104.46	5.83
70–71	12,239	1,400	114.42	5.45
71–72	10,839	1,358	125.27	5.09
72–73	9,481	1,300	137.09	4.75
73–74	8,181	1,226	149.92	4.42
74–75	6,955	1,140	163.86	4.12
75–76	5,815	1,041	178.97	3.82
76–77	4,774	933	195.34	3.55
77–78	3,841	818	213.04	3.29
78–79	3,023	702	232.17	3.05
79–80	2,321	587	252.81	2.82
80–81	1,734	477	275.07	2.60
81–82	1,257	376	299.06	2.39
82–83	881	286	324.86	2.20

TABLE 5.—*Life table for native-born males (1920) in the City of Manila*—Continued.

x to x+1, age interval, period of lifetime between two exact ages.	Of 100,000 males born alive.		1,000 qx, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}$x, expectation of life; average length of life remaining to those alive at beginning of age interval.
	lx, number alive at the beginning of age interval.	dx, number dying in age interval.		
			Annual rate.	*Age in years.*
83–84	595	210	352.62	2.03
84–85	385	147	382.44	1.86
85–86	238	99	414.44	1.69
86–87	139	62	448.78	1.55
87–88	77	37	485.57	1.40
88–89	40	21	524.98	1.25
89–90	19	11	567.16	1.11
90–91	8	5	612.26	1.00
91–92	3	2	660.47	0.83
92–93	1	1	711.96	0.50

TABLE 6.—*Life table for native born females (1920) in the City of Manila.*

x to x + 1, age interval, period of lifetime between two exact ages.	Of 100,000 females born alive.		1,000 qx, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}$x, expectation of life; average length of life remaining to those alive at beginning of age interval.
	lx, number alive at the beginning of age interval.	dx, number dying in age interval.		
			Annual rate.	*Age in years.*
0–1	100,000	19,255	192.55	35.94
1–2	80,745	6,740	83.47	43.39
2–3	74,005	3,413	46.12	46.30
3–4	70,592	1,773	25.11	47.52
4–5	68,819	1,158	16.82	47.73
5–6	67,661	580	8.57	47.54
6–7	67,081	511	7.62	46.94
7–8	66,570	458	6.88	46.30
8–9	66,112	418	6.32	45.62
9–10	65,694	390	5.93	44.90
10–11	65,304	371	5.68	44.17
11–12	64,933	361	5.56	43.42
12–13	64,572	359	5.56	42.66
13–14	64,213	363	5.66	41.89
14–15	63,850	374	5.85	41.13
15–16	63,476	387	6.10	40.37
16–17	63,089	405	6.42	39.61
17–18	62,684	425	6.78	38.87
18–19	62,259	446	7.17	38.13
19–20	61,813	469	7.58	37.40
20–21	61,344	507	8.26	36.68
21–22	60,837	513	8.44	35.98

TABLE 6.—*Life table for native-born females (1920) in the City of Manila*—Continued.

x to $x+1$, age interval, period of lifetime between two exact ages.	Of 100,000 females born alive.		1,000 q_x, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{\circ}{e}_x$, expectation of life; average length of life remaining to those alive at beginning of age interval.
	l_x, number alive at the beginning of age interval.	d_x, number dying in age interval.		
			Annual rate.	*Age in years.*
22–23	60,324	542	8.98	35.28
23–24	59,782	569	9.51	34.60
24–25	59,213	592	10.00	33.93
25–26	58,621	613	10.46	33.26
26–27	58,008	678	11.69	32.61
27–28	57,330	703	12.26	31.99
28–29	56.627	725	12.81	31.38
29–30	55,982	746	13.34	30.74
30–31	55,156	764	13.85	30.19
31–32	54,392	780	14.34	29.61
32–33	53,612	793	14.80	29.03
33–34	52,819	805	15.25	28.46
34–35	52,014	816	15.68	27.89
35–36	51,198	824	16.10	27.33
36–37	50,374	831	16.50	26.77
37–38	49,543	837	16.89	26.21
38–39	48,706	842	17.28	25.65
39–40	47,864	845	17.66	25.09
40–41	47,019	848	18.03	24.53
41–42	46.171	850	18.42	23.98
42–43	45,321	852	18.80	23.42
43–44	44,469	854	19.20	22.86
44–45	43,615	855	19.61	22.29
45–46	42,760	857	20.04	21.73
46–47	41,903	859	20.50	21.16
47–48	41,044	862	21.00	20.60
48–49	40,182	866	21.54	20.03
49–50	39,316	870	22.12	19.46
50–51	38,446	875	22.76	18.89
51–52	37,571	882	23.47	18.31
52–53	36,689	890	24.25	17.74
53–54	35,799	899	25.12	17.17
54–55	34,900	910	26.08	16.60
55–56	33,990	923	27.16	16.03
56–57	33,067	938	28.36	15.46
57–58	32,129	954	29.70	14.90
58–59	31,175	972	31.18	14.34
59–60	30,203	992	32.84	13.79
60–61	29,211	1,013	34.68	13.24
61–62	28,198	1,035	36.72	12.70
62–63	27,163	1,059	38.99	12.16
63–64	26,104	1,083	41.49	11.63
64–65	25,021	1,108	44.27	11.12
65–66	23,913	1,132	47.34	10.61

TABLE 6.—*Life table for native-born females (1920) in the City of Manila*—Continued.

x to x+1, age interval, period of lifetime between two exact ages.	Of 100,000 females born alive.		1,000 qx, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}_x$, expectation of life; average length of life remaining to those alive at beginning of age interval.
	lx, number alive at the beginning of age interval.	dx, number dying in age interval.		
			Annual rate.	*Age in years.*
66–67	22,781	1,155	50.72	10.11
67–68	21,626	1,177	54.44	9.62
68–69	20,449	1,197	58.53	9.15
69–70	19,252	1,213	63.02	8.69
70–71	18,039	1,226	67.94	8.24
71–72	16,813	1,233	73.33	7.80
72–73	15,580	1,234	79.23	7.38
73–74	14,346	1,229	85.66	6.97
74–75	13,117	1,216	92.68	6.55
75–76	11,901	1,194	100.31	6.20
76–77	10,707	1,163	108.62	5.84
77–78	9,544	1,123	117.65	5.49
78–79	8,421	1,073	127.44	5.16
79–80	7,348	1,014	138.06	4.84
80–81	6,334	947	149.55	4.53
81–82	5,387	873	161.98	4.24
82–83	4,514	792	175.42	3.96
83–84	3,722	707	189.92	3.70
84–85	3,015	620	205.56	3.45
85–86	2,395	533	222.40	3.21
86–87	1,862	448	240.54	2.99
87–88	1,414	368	260.05	2.77
88–89	1,046	294	281.01	2.57
89–90	752	228	303.53	2.38
90–91	524	172	327.68	2.20
91–92	352	124	353.58	2.03
92–93	228	87	381.33	1.87
93–94	141	58	411.05	1.72
94–95	83	37	442.83	1.57
95–96	46	22	476.82	1.43
96–97	24	12	513.14	1.29
97–98	12	7	551.92	1.17
98–99	5	3	593.31	1.10
99–100	2	1	637.45	1.02
100–101	1	1	684.51	0.51

TABLE 7.—*Life table for native-born, both sexes (1920), in the City of Manila.*

x to x+1, age interval, period of lifetime between two exact ages.	Of 100,000 persons (both sexes) born alive.		1,000 qx, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}x$, expectation of life; average length of life remaining to each one alive at beginning of age interval.
	lx, number alive at the beginning of age interval.	dx, number dying in age interval.		
			Annual rate.	*Age in years.*
0–1	100,000	21,538	215.38	34.25
1–2	78,462	6,701	85.40	42.51
2–3	71,761	3,297	45.94	45.44
3–4	68,464	1,894	27.66	46.60
4–5	66,570	1,315	19.76	46.91
5–6	65,255	572	8.77	46.85
6–7	64,683	508	7.85	46.26
7–8	64,175	458	7.13	45.62
8–9	63,717	421	6.61	44.94
9–10	63,296	396	6.25	44.24
10–11	62,900	380	6.04	43.51
11–12	62,520	373	5.96	42.78
12–13	62,147	372	5.99	42.03
13–14	61,775	378	6.12	41.28
14–15	61,397	389	6.34	40.53
15–16	61,008	403	6.61	39.79
16–17	60,605	421	6.94	39.05
17–18	60,184	440	7.31	38.32
18–19	59,744	459	7.69	37.59
19–20	59,285	480	8.09	36.88
20–21	58,805	514	8.74	36.18
21–22	58,291	518	8.88	35.49
22–23	57,773	540	9.34	34.81
23–24	57,233	558	9.75	34.13
24–25	56,675	574	10.12	33.46
25–26	56,101	587	10.46	32.80
26–27	55,514	633	11.40	32.14
27–28	54,881	650	11.84	31.51
28–29	54,231	665	12.26	30.88
29–30	53,566	679	12.67	30.25
30–31	52,887	691	13.06	29.64
31–32	52,196	702	13.45	29.02
32–33	51,494	712	13.82	28.41
33–34	50,782	721	14.19	27.80
34–35	50,061	728	14.55	27.20
35–36	49,333	736	14.91	26.59
36–37	48,597	742	15.27	25.98
37–38	47,855	748	15.63	25.38
38–39	47,107	754	16.00	24.75
39–40	46,353	760	16.39	24.17
40–41	45,593	766	16.79	23.56
41–42	44,827	771	17.21	22.96
42–43	44,056	778	17.67	22.35

TABLE 7.—*Life table for native-born, both sexes (1920), in the City of Manila*—Continued.

x to x+1, age interval, period of lifetime between two exact ages.	Of 100,000 persons (both sexes) born alive.		1,000 qx, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}_x$, expectation of life; average length of life remaining to each one alive at beginning of age interval.
	lx, number alive at the beginning of age interval.	dx, number dying in age interval.		
			Annual rate.	*Age in years.*
43–44	43,278	785	18.15	21.74
44–45	42,493	793	18.67	21.14
45–46	41,700	802	19.24	20.53
46–47	40,898	812	19.86	19.92
47–48	40,086	824	20.55	19.32
48–49	39,262	836	21.30	18.71
49–50	38,426	851	22.14	18.11
50–51	37,575	866	23.06	17.51
51–52	36,709	884	24.09	16.91
52–53	35,825	904	25.23	16.31
53–54	34,921	925	26.50	15.72
54–55	33,996	948	27.90	15.13
55–56	33,048	974	29.46	14.55
56–57	32,074	1,000	31.19	13.98
57–58	31,074	1,029	33.10	13.42
58–59	30,045	1,058	35.22	12.86
59–60	28,987	1,088	37.55	12.31
60–61	27,899	1,120	40.13	11.77
61–62	26,779	1,151	42.97	11.24
62–63	25,628	1,181	46.09	10.72
63–64	24,447	1,211	49.53	10.22
64–65	23,236	1,238	53.30	9.72
65–66	21,998	1,263	57.43	9.24
66–67	20,735	1,284	61.94	8.78
67–68	19,451	1,301	66.88	8.32
68–69	18,150	1,312	72.28	7.88
69–70	16,838	1,316	78.15	7.46
70–71	15,522	1,312	84.55	7.05
71–72	14,210	1,300	91.51	6.65
72–73	12,910	1,279	99.08	6.27
73–74	11,631	1,248	107.29	5.91
74–75	10,383	1,206	116.18	5.56
75–76	9,177	1,155	125.81	5.22
76–77	8,022	1,093	136.24	4.90
77–78	6,929	1,022	147.50	4.59
78–79	5,907	943	159.65	4.30
79–80	4,964	858	172.76	4.02
80–81	4,106	767	186.90	3.76
81–82	3,339	675	202.11	3.51
82–83	2,664	582	218.47	3.27
83–84	2,082	491	236.07	3.05
84–85	1,591	406	254.96	2.84
85–86	1,185	326	275.23	2.63
86–87	859	255	296.98	2.44
87–88	604	193	320.28	2.26
88–89	411	142	345.23	2.09

TABLE 7.—*Life table for native-born, both sexes (1920), in the City of Manila*—Continued.

x to x+1, age interval, period of lifetime between two exact ages.	Of 100,000 persons (both sexes) born alive.		1,000 qx, rate of mortality per thousand; number dying in age interval among 1,000 alive at beginning of age interval.	$\overset{o}{e}_x$, expectation of life; average length of life remaining to each one alive at beginning of age interval.
	lx, number alive at the beginning of age interval.	dx, number dying in age interval.		
			Anual rate.	*Age in years.*
89–90	269	100	371.94	1.93
90–91	169	68	400.49	1.78
91–92	101	44	431.01	1.63
92–93	57	26	463.61	1.51
93–94	31	15	498.40	1.35
94–95	16	9	535.52	1.19
95–96	7	4	575.09	1.14
96–97	3	2	617.26	0.83
97–98	1	1	662.18	0.27

TABLE 8.—*Life table for native-born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii, both sexes (1920), and colored people, males and females, in the original Registration States, United States, for the year 1910.*

x to x+1, age interval, period of lifetime between two exact ages.	$\overset{o}{e}_x$, expectation of life, both sexes, in years.						
	Manila.	In Hawaii.				Colored people in the original Registration States, 1910.	
		Filipinos.	Japanese.	Chinese.	Hawaiians.	Males.	Females.
0–1	34.25	36.93	51.88	52.28	29.00	34.05	37.67
1–2	42.51	49.02	56.22	56.37	36.60	42.53	45.15
2–3	45.44	50.80	56.54	56.25	37.34	44.55	46.95
3–4	46.60	50.98	56.11	55.74	37.14	45.01	47.12
4–5	46.91	50.73	55.56	55.17	36.71	44.78	46.87
5–6	46.85	50.17	54.97	54.55	36.13	44.25	46.42
6–7	46.26	49.56	54.28	53.84	35.45	43.62	45.81
7–8	45.62	48.84	53.51	53.08	34.73	42.94	45.13
8–9	44.94	48.06	52.69	52.27	33.99	42.20	44.39
9–10	44.24	47.25	51.84	51.43	33.25	41.44	43.62
10–11	43.51	46.25	50.97	50.57	32.52	40.65	42.84
11–12	42.78	45.59	50.10	49.71	31.81	39.85	42.06
12–13	42.03	44.77	49.23	48.85	31.13	39.05	41.29
13–14	41.28	43.96	48.37	47.96	30.49	38.27	40.56
14–15	40.53	43.17	47.54	47.15	29.88	37.51	39.85
15–16	39.79	42.41	46.74	46.32	29.31	36.77	39.18
16–17	39.05	41.69	45.96	45.47	28.77	36.05	38.55
17–18	38.32	40.99	45.21	44.67	28.27	35.37	37.95
18–19	37.59	40.31	44.49	43.91	27.81	34.71	37.35
19–20	36.88	39.67	43.79	43.16	27.38	34.08	36.75

TABLE 8.—*Life table for native-born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii, both sexes (1920), and colored people, males and females, in the original Registration States, United States, for the year 1910*—Continued.

x to x+1, age interval, period of lifetime between two exact ages.	$\overset{o}{e}_x$, expectation of life, both sexes, in years.						
	Manila.	In Hawaii.				Colored people in the original Registration States, 1910.	
		Filipinos.	Japanese.	Chinese.	Hawaiians.	Males.	Females.
20–21	36.18	39.04	43.12	42.44	26.97	33.46	36.14
21–22	35.49	38.43	42.47	41.73	26.58	32.86	35.53
22–23	34.81	37.82	41.82	41.03	26.20	32.26	34.90
23–24	34.13	37.21	41.17	40.35	25.81	31.67	34.27
24–25	33.46	36.60	40.52	39.48	25.42	31.06	33.63
25–26	32.80	35.98	39.36	39.00	25.03	30.44	32.97
26–27	32.14	35.36	39.21	38.33	24.64	29.81	32.29
27–28	31.51	34.73	38.55	37.67	24.25	29.18	31.61
28–29	30.88	34.11	37.89	37.01	23.86	28.55	30.94
29–30	30.25	33.48	37.23	36.35	23.47	27.94	30.27
30–31	29.64	32.86	36.57	35.70	23.07	27.33	29.61
31–32	29.02	32.23	35.91	35.05	22.68	26.74	28.96
32–33	28.41	31.61	35.23	34.39	22.28	26.16	28.33
33–34	27.80	30.98	34.56	33.74	21.89	25.58	27.70
34–35	27.20	30.35	33.88	33.08	21.49	25.00	27.07
35–36	26.59	29.73	33.20	32.43	21.09	24.42	26.44
36–37	25.98	29.09	32.52	31.75	20.68	23.84	25.81
37–38	25.38	28.46	31.83	31.06	20.27	23.26	25.18
38–39	24.75	27.83	31.14	30.41	19.86	22.69	24.56
39–40	24.17	27.19	30.45	29.74	19.47	22.12	23.94
40–41	23.56	26.56	29.76	29.06	19.05	21.57	23.34
41–42	22.96	25.92	29.06	28.37	18.63	21.02	22.75
42–43	22.35	25.28	28.36	27.68	18.21	20.48	22.16
43–44	21.74	24.64	27.67	26.99	17.79	19.94	21.58
44–45	21.14	24.00	26.96	26.29	17.37	19.39	21.00
45–46	20.53	23.36	25.56	25.59	16.93	18.85	20.43
46–47	19.92	22.72	25.56	24.88	16.51	18.30	19.86
47–48	19.32	22.08	24.86	24.17	16.16	17.75	19.30
48–49	18.71	21.44	24.17	23.46	15.65	17.22	18.75
49–50	18.11	20.80	23.47	22.75	15.21	16.71	18.20
50–51	17.51	20.16	22.77	22.03	14.78	16.21	17.65
51–52	16.91	19.53	22.08	21.32	14.35	15.72	17.10
52–53	16.31	18.90	21.40	20.61	13.91	15.23	16.55
53–54	15.72	18.27	21.71	19.90	13.48	14.75	16.01
54–55	15.13	17.65	20.04	19.19	13.05	14.28	15.48
55–56	14.55	17.04	19.37	18.49	12.62	13.82	14.98
56–57	13.98	16.43	18.71	17.79	12.20	13.36	14.50
57–58	13.42	15.83	18.06	17.10	11.77	12.93	14.05
58–59	12.86	15.23	17.41	16.41	11.35	12.50	13.62
59–60	12.31	14.64	16.78	15.73	10.94	12.08	13.20

TABLE 8.—*Life table for native-born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii, both sexes (1920), and colored people, males and females, in the original Registration States, United States, for the year 1910*—Continued.

x to x+1, age interval, period of lifetime between two exact ages.	$\overset{o}{e}_x$, expectation of life, both sexes, in years.						
	Manila.	In Hawaii.				Colored people in the original Registration States, 1910.	
		Filipinos.	Japanese.	Chinese.	Hawaiians.	Males.	Females.
60–61	11.77	14.07	16.15	15.07	10.53	11.67	12.78
61–62	11.24	13.50	15.54	14.41	10.12	11.27	12.37
62–63	10.72	12.94	14.93	13.77	9.72	10.88	11.96
63–64	10.22	12.39	14.32	13.14	9.33	10.49	11.56
64–65	9.72	11.86	13.71	12.52	8.94	10.11	11.18
65–66	9.24	11.33	13.10	11.97	8.56	9.74	10.82
66–67	8.78	10.82	12.50	11.33	8.19	9.38	10.49
67–68	8.32	10.32	11.91	10.75	7.83	9.02	10.17
68–69	7.88	9.84	11.32	10.20	7.74	8.67	9.86
69–70	7.46	9.37	10.74	9.66	7.12	8.33	9.54
70–71	7.05	8.91	10.17	9.14	6.79	8.00	9.22
71–72	6.65	8.46	9.62	8.63	6.46	7.69	8.89
72–73	6.27	8.03	9.06	8.15	6.14	7.39	8.55
73–74	5.91	7.62	8.55	7.68	5.83	7.11	8.21
74–75	5.56	7.22	8.05	7.23	5.53	6.84	7.88
75–76	5.22	6.83	7.56	6.80	5.24	6.58	7.55
76–77	4.90	6.46	7.09	6.39	4.96	6.36	7.22
77–78	4.59	6.10	6.64	6.00	4.69	6.15	6.91
78–79	4.30	5.76	6.21	5.62	4.43	5.96	6.61
79–80	4.02	5.43	5.81	5.27	4.17	5.76	6.32
80–81	3.76	5.17	5.44	4.93	3.93	5.53	6.05
81–82	3.51	4.82	5.05	4.60	3.69	5.29	5.81
82–83	3.27	4.53	4.71	4.30	3.47	5.06	5.59
83–84	3.05	4.25	4.38	4.01	3 .30	4.84	5.40
84–85	2.84	3.99	4.07	3.73	3.10	4.64	5.23
85–86	2.63	3.74	3.78	3.47	2.91	4.48	5.09
86–87	2.44	3.50	3.51	3.23	2.72	4.36	4.97
87–88	2.26	3.27	3.25	3.00	2.55	4.26	4.86
88–89	2.09	3.05	3.08	2.78	2.38	4.18	4.76
89–90	1.93	2.84	2.79	2.57	2.22	4.10	4.64
90–91	1.78	2.64	2.59	2.38	2.06	4.01	4.50
91–92	1.63	2.44	2.39	2.20	1.91	3.89	4.34
92–93	1.51	2.24	2.21	2.03	1.77	3.75	4.14
93–94	1.35	2.17	2.04	1.87	1.62	3.57	3.92
94–95	1.91	2.02	1.89	1.70	1.45	3.37	3.69
95–96	1.14	1.87	1.74	1.58	1.32	3.15	3.45
96–97	0.83	1.74	1.60	1.45	1.24	2.93	3.22
97–98	0.27	1.61	1.48	1.33	1.04	2.72	2.99

TABLE 8.—*Life table for native-born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii, both sexes (1920), and colored people, males and females, in the original Registration States, United States, for the year 1910*—Continued.

x to x+1, age interval, period of lifetime between two exact ages.	$\overset{o}{e}_x$, expectation of life, both sexes, in years.						
	Manila.	In Hawaii.				Colored people in the original Registration States, 1910.	
		Filipinos.	Japanese.	Chinese.	Hawaiians.	Males.	Females.
98-99	--------	1.49	1.36	1.22	.70	2.51	2.78
99-100	--------	1.38	1.24	1.10	--------	2.32	2.58
100-101	--------	1.29	1.13	1.00	--------	2.14	2.39
101-102	--------	1.22	1.02	.65	--------	1.97	2.21
102-103	--------	1.20	.89	--------	--------	1.81	2.05
103-104	--------	.13	.65	--------	--------	1.66	1.89
104-105	--------	--------	--------	--------	--------	1.53	1.74
105-106	--------	--------	--------	--------	--------	1.40	1.59
106-107	--------	--------	--------	--------	--------	1.27	1.45
107-108	--------	--------	--------	--------	--------	1.16	1.32
108-109	--------	--------	--------	--------	--------	--------	1.20
109-110	--------	--------	--------	--------	--------	--------	1.08

ACKNOWLEDGMENT

I am indebted to Maj. Paul R. Hawley, of the Medical Corps, United States Army, for valuable suggestions and assistance in the preparation of this paper; to Dr. Jose Guidote, chief of the division of vital statistics of the Philippine Health Service, who furnished the mortality data; to Sanitary Inspector Basilio Martinez, who prepared the charts accompanying the paper; and to Sanitary Inspector Amado Castillo and Clerk Victorio Yabot, for their assistance.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Diagram of life table for native-born in the City of Manila, for the year 1920.
2. Diagram of life table for native-born in the City of Manila, for the year 1920.
3. Diagram of life table for native-born in the City of Manila, for the year 1920.
4. Diagram of life tables for native-born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii (both sexes) for the year 1920, and colored people (males and females) in the original Registration States (United States) for the year 1910.
5. Diagram of life tables for native-born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii (both sexes) for the year 1920, and colored people (males and females) in the original Registration States (United States) for the year 1910.
6. Diagram of life tables for native-born in the City of Manila and of Filipinos, Japanese, Chinese, and Hawaiians in Hawaii (both sexes) for the year 1920, and colored people (males and females) in the original Registration States (United States) for the year 1910.

THERMAL AND PHOTOCHEMICAL DECOMPOSITION OF CARYOPHYLLENE NITROSITE

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FOUR TEXT FIGURES

Few photochemical reactions are known which are brought about by red light, although many are known which are responsive to blue light or ultra-violet light. The red-sensitive reactions are particularly favorable for study, because the intensity of red light from an ordinary lamp is much greater than the intensity of blue light, and quantitative experiments with monochromatic light are facilitated. Furthermore, according to certain hypotheses connecting photochemical reactions with thermal reactions, infra red or red light should be photochemically active, and a reaction brought about by red light becomes especially valuable if it can be brought about also by thermal means.

Prof. Edward Kremers discovered that caryophyllene nitrosite is decomposed by red light and it was the purpose of this research to study the reactions quantitatively with new and improved photochemical apparatus and to determine if the reaction can be brought about also by ordinary heating. The quantitative study of the decomposition rate at approximately 80, 100, and 110° C. is described in this paper, and it is planned to study the photochemical decomposition very shortly.

Caryophyllene nitrosite was first made by Schreiner and James [1] by following the method of Chapman [2] used in preparing humulene nitrosite. Later Schreiner and Kremers [3] prepared this compound and observed the action of sunlight on the sub-

[1] Pharm. Arch. 1 (1898) 213.

[2] Journ. Chem. Soc. 67 (1895) 782.

[3] Pharm. Arch. 2 (1899) 14.

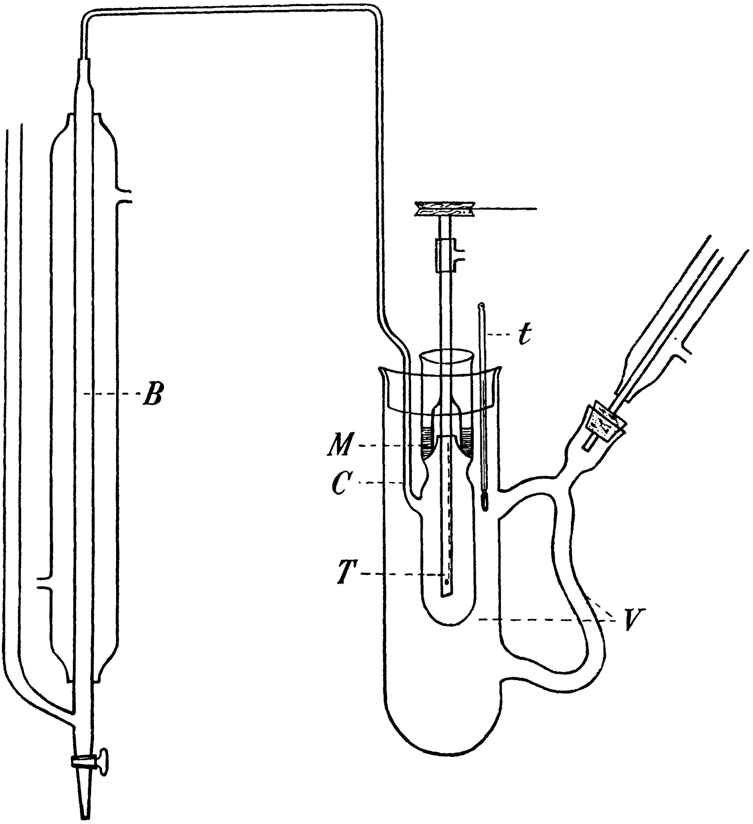

FIG. 1. Apparatus for the thermal decomposition of caryophyllene nitrosite.

stance dissolved in benzene solution. It was observed that when the perfectly blue solution in benzene was exposed to sunlight the solution almost immediately began to give off a gas, while small feltlike and perfectly white crystals began to separate. The liberated gas was considered to be nitrogen. By using a nitrometer the compound dissolved in benzene solution was found to evolve about 28.94 per cent of total nitrogen, whereas 10.19 per cent of the same gas was liberated from the alcoholic solution. A few years ago, Professor Kremers and some of his students [4] studied further the action of sunlight on caryophyllene nitrosite solution and its mother liquid. Quantitative measurements of the gas were made.

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[4] Manuscripts.

DESCRIPTION OF APPARATUS

The apparatus used in the thermal decomposition experiments was that shown in fig. 1. The solution was placed in a tube *T* provided with a mercury seal *M*. The side tube *C* with very small diameter is connected with small glass tubing (almost capillary) which is connected with a 50-cubic-centimeter burette *B*, jacketed in a condenser in which the gas evolved was collected. The condenser was used to keep the temperature of the water surrounding the burette practically the same. The tube *T* containing the solution was jacketed in a vapor thermostat *V*, which is connected with a small condenser. The vapor thermostat contained the liquid the boiling point of which approached the temperature at which it was desired that the decomposition should take place. A thermometer *t*, accurate to 0.1 °, was inserted through the cork in order to observe the temperature at which the decomposition was taking place. All connections were made gas tight.

MATERIAL

The caryophyllene nitrosite used in this work was kindly furnished by Professor Kremers of the Department of Pharmacy. It was prepared several years ago by him and his students, according to the method of Schreiner and Kremers.[5] In spite of having been allowed to stand for a long time in an open container, the substance still possessed the fine needlelike bright blue crystalline form, melting at 115° C. Only few of the exposed crystals on the surface had undergone slight change in color, from bright blue to slightly yellowish brown. These crystals melted at 110° C. In our experiments care was always taken to use the bright blue crystals, melting at 115° C. They readily dissolve in alcohol, benzene, and carbon tetrachloride, giving a blue solution, while if dissolved in nitrobenzene the color is somewhat greenish. On exposure to sunlight the solution is decolorized and an insoluble white compound is formed in alcohol, benzene, and carbon tetrachloride.[6] In nitrobenzene, the solution changes from greenish blue to brownish without the formation of a white product of decomposition.

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[5] Pharm. Arch. 2 (1899) 14.

[6] Cf. O. Schreiner and E. Kremers, Pharm. Arch. 2 (1899) 273; Ibid, 6 (1903) 130–131; also E. Deussen, Ann. 388 (1912) 139.

The following solvents were employed:

Nitrobenzene.—The nitrobenzene used was that manufactured by Merck and Company.

Paraffine.—The paraffine was obtained from the Standard Oil Company of Indiana.

Limonene.—The limonene was kindly furnished by Dr. Nellie Wakeman, of the Laboratory of Plant Chemistry, University of Wisconsin, who rectified it from commercial orange oil.

EXPERIMENTAL PROCEDURE

A sufficient amount of the desired liquid was poured into the vapor thermostat. Twenty cubic centimeters of the solvent were pipetted into the tube and the liquid in the thermostat was heated to boiling by means of an electric heater. The boiling was allowed to continue for thirty minutes. Then 1 gram of the substance, made into a pellet, was dropped into the tube and the solution was constantly stirred by means of an electric stirrer.

The rate of decomposition was measured by taking the volume readings at measured intervals. The burette in which the gas was collected was filled in every case with nitrobenzene and the level in the burette and that in the side tube were made to agree at every reading of the volume of the gas evolved. The final observation was made when no further increase in volume was noticed. To find out the length of time that would be required to obtain the final volume, the apparatus was allowed to remain undisturbed for forty-eight hours. During this period the readings were taken at intervals of twelve hours. The final volume in this case differs only slightly from the reading which was taken after two hours' standing.

The solvents used were nitrobenzene, melted paraffine, and rectified limonene. The liquids employed in the thermostat were carbon tetrachloride (76° C.), distilled water (100° C.), and toluene, chemically pure (110° C.). Different solvents were used to see whether or not the decomposition is affected by the nature of the solvent. The solvent was always heated for thirty minutes previous to the dropping of the substance in order to avoid the effect of unequal temperature at the beginning of the experiment.

CALCULATIONS

Figure 2 shows the curves obtained by plotting the volume of the gas evolved during the thermal decomposition of caryophyllene nitrosite dissolved in nitrobenzene. The decomposition at the boiling point of carbon tetrachloride is represented by curve A. Curve B shows the decomposition at 100° C. (water), and curve C shows the decomposition at 110° C. (toluene).

Figure 3 represents the graphic grouping of the results obtained from the decomposition of caryophyllene nitrosite in limonene solution. Curve A represents the results at the boiling point of carbon tetrachloride, curve B at 100° C., and curve C at 110° C.

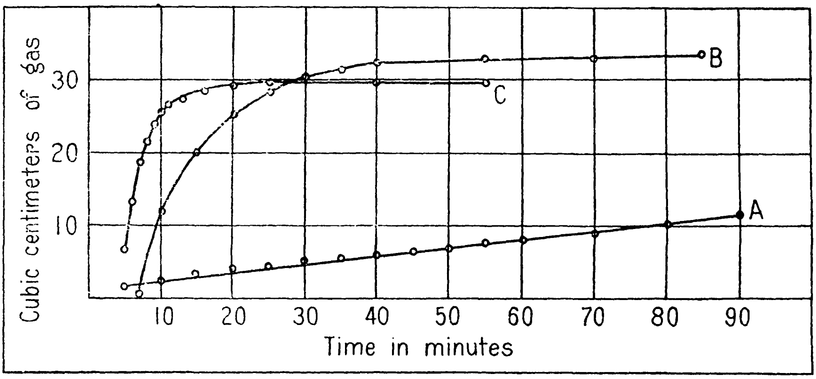

FIG. 2. Thermal decomposition of caryophyllene nitrosite dissolved in nitrobenzene.

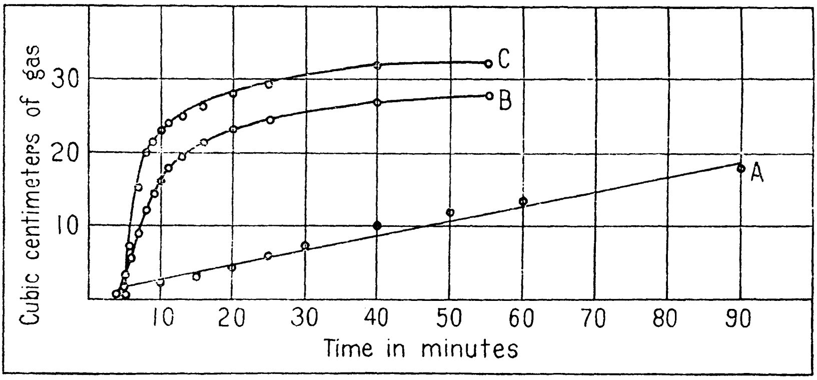

FIG. 3. Thermal decomposition of caryophyllene nitrosite dissolved in limonene.

Figure 4 gives the curves obtained when the caryophyllene nitrosite was decomposed in melted paraffine. The results at 100° C. (water) are represented by curve A, while curve B shows the decomposition at 110° C. (toluene). In this case the paraffine was first melted and then the caryophyllene nitrosite pellet was dropped into it. The decomposition at lower temperature was not studied.

Tables 1, 2, and 3 give the decomposition of caryophyllene nitrosite carried out under different conditions. The first section gives the time readings expressed in seconds; the second gives the volume readings in cubic centimeters of the gas evolved at each interval; the third gives the difference between the final volume V and the volume at any time V_t, and the fourth gives the velocity constants. The columns give the respective results obtained at the boiling points of the liquids used in the vapor thermostat; namely, carbon tetrachloride, water, and toluene. The reaction velocity constants were calculated directly from the data given in the columns, with the aid of the following formula:

$$K = \frac{2.302}{t_2 - t_1} \log. \frac{V\infty - V_{t_1}}{V\infty - V_{t_2}}$$

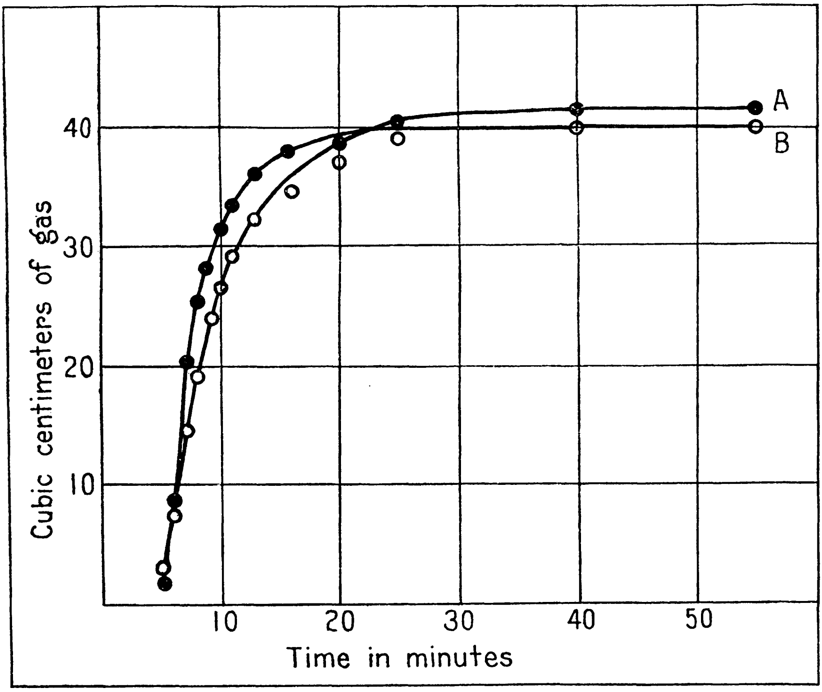

FIG. 4. Thermal decomposition of caryophyllene nitrosite dissolved in paraffine.

TABLE 1.—*Thermal decomposition of caryophyllene nitrosite in nitrobenzene solution.*

Time in seconds.			Volume of gas evolved.			Difference between final volume and volume at any time.			Velocity constant		
Carbon tetrachloride. t	Water. t	Toluene. t	Carbon tetrachloride. $V_o = 1.8$	Water. $V_o = 11.2$	Toluene. $V_o = 5.5$	Carbon tetrachloride. $V_\infty = 25.2$	Water. $V_\infty = 41.7$	Toluene. $V_\infty = 29.9$	Carbon tetrachloride. $K \times 10^{-4}$	Water. $K \times 10^{-4}$	Toluene. $K \times 10^{-3}$
			cc.	*cc.*	*cc.*	*cc.*	*cc.*	*cc.*			
0	0	0	1.8	11.2	5.5						
300	300	60	2.4	20.65	13.8	23.40	21.05	24.4	0.85	8.12	6.92
600	600	120	3.2	25.20	18.8	22.80	16.50	16.1	1.17	6.91	6.20
900	900	180	3.8	28.3	21.8	22.0	13.40	11.1	0.91	5.37	5.24
1200	1200	240	4.3	30.3	24.0	21.4	11.50	8.10	0.75	3.19	5.26
1500	1500	300	4.8	31.35	25.3	20.09	10.35	5.9	0.94	2.52	1.38
1800	1800	480	5.4	32.1	27.45	20.04	9.6	4.6	0.98	3.68	1.50
2100	2700	900	5.9	33.1	29.00	19.80	8.6	2.45	0.97	1.99	1.67
2400	4500	1200	6.5	34.6	29.5	19.3	8.1	0.9	0.94	1.69	0.90
2700		2100	7.0		29.7	18.70		0.4	0.88		0.77
3000			7.5			17.70			0.91		
3300			8.1			17.1			.82		
5400			12.8			12.4			1.94		
8760			17.8			7.4			1.37		

TABLE 2.—*Thermal decomposition of caryophyllene nitrosite in limonene solution.*

Time in seconds.			Volume of gas evolved.			Difference between final volume and volume at any time.			Velocity constant.		
Carbon tetrachloride. t	Water. t	Toluene. t	Carbon tetrachloride. $V_o = 1.8$	Water. $V_o = 3.1$	Toluene. $V_o = 0.2$	Carbon tetrachloride. $V_\infty = 21.6$	Water. $V_\infty = 19.9$	Toluene. $V_\infty = 32.3$	Carbon tetrachloride. $K \times 10^{-4}$	Water. $K \times 10^{-4}$	Toluene. $K \times 10^{-3}$
			cc.	*cc.*	*cc.*	*cc.*	*cc.*	*cc.*			
0	0	0	1.8	3.1	0.2						
300	60	60	2.5	5.9	7.2	19.8	26.8	32.10	1.00	1.84	4.08
600	120	120	3.3	9.4	16.2	19.2	24.0	25.1	1.60	2.63	7.33
900	180	180	4.7	12.4	20.0	18.3	20.5	16.10	2.62	2.64	4.46
1200	240	240	6.0	14.8	21.80	16.9	17.5	12.30	2.62	2.46	2.62
1500	300	300	7.4	16.5	22.9	15.6	15.1	9.40	1.57	2.00	1.82
2100	360	360	10.0	17.80	23.8	14.2	13.4	8.50	3.35	1.70	1.66
2700	480	420	12.0	19.70	25.2	11.1	12.1	7.10	3.14	2.28	1.44
3300	660	540	13.7	21.70	26.60	9.60	8.2	5.70	2.15	0.94	0.91
4200	900	620	15.5	23.35	28.00	7.9	6.55	4.30	1.43	0.93	0.93
6000	1200	----------	18.10	24.60	----------	6.1	5.30	----------	1.54	0.70	----------
9600	----------	----------	20.4	----------	----------	3.5	----------	----------	2.98	----------	----------

TABLE 3.—*Thermal decomposition of caryophyllene nitrosite dissolved in melted paraffine.*

Time in seconds.		Volume of gas evolved.		Difference between final volume and volume at any time.		Velocity constant.	
Water. t	Toluene. t	Water. $V_o=3.0$	Toluene. $V_o=2.0$	Water. $V_\infty=41.6$	Toluene. $V_{oo}=40$	Water. $K\times10^{-3}$	Toluene. $K\times10^{-3}$
		cc.	*cc.*	*cc.*	*cc.*		
0	0	3.0	2.0	----------	----------	----------	----------
60	60	8.8	8.0	38.60	32	2.71	8.25
120	120	14.7	20.50	32.80	19.5	3.30	4.91
180	180	19.60	25.50	26.90	14.00	3.34	3.57
240	240	24.0	28.3	22.00	11.70	3.71	5.22
300	300	26.90	31.5	17.60	8.50	2.99	4.89
360	360	29.20	33.7	14.70	6.30	1.41	3.99
480	----------	32.30	36.10	12.40	----------	0.69	3.71
660	----------	34.80	----------	9.30	----------	3.84	----------

TABLE 4.—*Velocity constants.*

Solvents.	Nitrobenzene.			Limonene.
Liquids in vapor thermostats.	Carbon tetrachloride.	Water.	Toluene.	Carbon tetrachloride.
Maximum	1.94×10^{-4}	8.12×10^{-4}	6.92×10^{-3}	3.35×10^{-4}
Minimum	0.75×10^{-4}	1.69×10^{-4}	0.77×10^{-3}	1.00×10^{-4}
Mean	1.03×10^{-4}	4.30×10^{-4}	3.31×10^{-3}	2.18×10^{-4}

Solvents.	Limonene.		Paraffine.	
Liquids in vapor thermostats.	Water.	Toluene.	Water.	Toluene.
Maximum	2.64×10^{-3}	7.33×10^{-3}	3.84×10^{-3}	8.25×10^{-3}
Minimum	0.70×10^{-3}	0.91×10^{-3}	0.69×10^{-3}	3.71×10^{-3}
Mean	1.81×10^{-3}	2.80×10^{-3}	2.64×10^{-3}	4.91×10^{-3}

RESULTS

A glance at the columns of the velocity constants reveals considerable variation in the figures; Table 4 gives the maximum, minimum, and mean values obtained in each case. These values were calculated from experiments carried in duplicate which gave figures agreeing closely within permissible error. The figures at low temperature seem to agree more closely than the values calculated from the data obtained at the boiling point of carbon tetrachloride, less than 100 and 110° C. Apparently, the decomposition of caryophyllene nitrosite is not a simple reaction, but is a more or less complex one. Semmler and Jakubowicz[7] observed that most of the sesquiterpenes are decomposed when heated for several hours at higher temperature. Although the temperature at which Semmler and Jakubowicz[7] decomposed the sesquiterpenes was 330° C., it is possible that secondary stages of decomposition are also involved in the heating of caryophyllene nitrosite, thus rendering the reaction complex.

Considering, however, the mean velocity constants obtained from each of our experiments, the following facts are apparent:

1. The velocity of the decomposition is influenced by the nature of the solvent, which is in agreement with the observation of Menshtkin.[8] Thus, comparing the reaction velocity constants in melted paraffine and in limonene at the same temperature, 110° C., the velocity is shown to differ in the two cases.

2. The compound behaves rather abnormally with regard to the relation between the velocity of the reaction and the temperature. Thus, in case of the solution in nitrobenzene, for a difference of about 24° C., the velocity was increased four times, whereas in the case of water and of toluene, the velocity was increased seven times. The behavior of the solution in limonene was different from the first one, since the velocity was about nine times greater from the boiling point of carbon tetrachloride and of water, whereas it increased twice its velocity at from 100 to 110° C.

In melted paraffine the velocity was doubled at from 100 to 110° C. From these results it appears that, while the increase in the velocity was abnormal in nitrobenzene, yet it seemed to follow the general rule (velocity of the reaction is doubled at an increase of 10° C.) when decomposed at from 100 to 110° C. in solutions of limonene and of paraffine.

Although the experimental data show that reaction is rather complex, and suggest that two or more reactions are taking place simultaneously, it is believed that the temperature coefficient of the reaction rate may permit a fairly close approximation of the energy required to bring about the reaction, and that this energy may be checked with the energy required to bring about the photochemical reaction.

We are indebted to Prof. Edward Kremers who indicated the behavior of caryophyllene nitrosite toward sunlight and who suggested that this study be made.

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[7] Berichte 47 (1914) 2252-2259.

[8] Zeit. Phys. Chem. 6 (1890) 41.

ILLUSTRATIONS

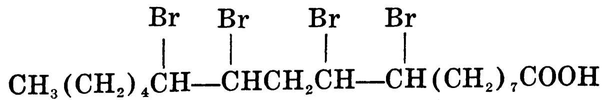
TEXT FIGURES

FIG. 1. Apparatus for the thermal decomposition of caryophyllene nitrosite.
2. Chart showing the thermal decomposition of caryophyllene nitrosite dissolved in nitrobenzene.
3. Chart showing the thermal decomposition of caryophyllene nitrosite dissolved in limonene.
4. Chart showing the thermal decomposition of caryophyllene nitrosite dissolved in paraffine.

ESTERS OF ALPHA LINOLIC ACID TETRABROMIDE (METHYL, ETHYL, PROPYL, ISOPROPYL, AND ALLYL) FROM LUMBANG OIL

By IRENE SANTOS
Assistant in Chemistry, University of the Philippines
and
AUGUSTUS P. WEST
Professor of Chemistry, University of the Philippines

Linolenic and linolic glycerides are the important constituents of vegetable drying oils, since these are the substances that absorb oxygen from the air and cause the oil to dry. Philippine lumbang oil[1] consists almost entirely of glycerides of the unsaturated acids linolenic, linolic, and oleic.[2] It is a drying oil and is used in making paints, varnishes, and similar products.[3] When the mixed acids obtained from the glycerides of lumbang oil are brominated there is obtained a mixture of bromo derivatives of the unsaturated acids linolenic, linolic, and oleic. A recent investigation[4] indicated that four different linolic tetrabromides can be separated from this mixture of bromo derivatives. Although the free linolic acids oxidize readily, the linolic tetrabromides are very stable compounds and consequently are important substances in the chemistry of vegetable drying oils. A fair yield of crystallized alpha linolic tetrabromide can be obtained from lumbang oil.



$$\mathrm{CH_3(CH_2)_4\overset{Br}{\overset{|}{C}}H{-}\overset{Br}{\overset{|}{C}}HCH_2\overset{Br}{\overset{|}{C}}H{-}\overset{Br}{\overset{|}{C}}H(CH_2)_7COOH}$$

alpha linolic tetrabromide

Various salts[5] of this substance have been made and the solubility of these salts in different solvents has been determined.

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[1] West, A. P., and W. H. Brown, Bull. Philip. Bur. Forestry 20 (1920) 121.

[2] West, A. P., and Z. Montes, Philip. Journ. Sci. 18 (1921) 619.

[3] West, A. P., and F. L. Smith, Bull. Philip. Bur. Forestry 24 (1923).

[4] Santiago, S., and A. P. West, Philip. Journ. Sci. 32 (1927) 41.

[5] Oreta, A. T., and A. P. West, Philip. Journ. Sci. 33 (1927) 169; Jovellanos, C. M., and A. P. West, Philip. Journ. Sci. 33 (1927) 349.

In the present investigation a few esters of alpha linolic tetrabromide have been prepared. The esters did not give a very sharp melting point. In this respect they appear to resemble salts of long-chain acids since, according to the literature,[6] many of these salts do not give a sharp melting point.

EXPERIMENTAL PROCEDURE

Preparation of alpha linolic tetrabromide.—Philippine lumbang oil was used as the material for preparing a supply of alpha linolic tetrabromide. The lumbang oil was pressed from seeds of good quality and filtered first through glass wool and then through filter paper.

The alpha linolic tetrabromide was prepared from lumbang oil, in accordance with the procedure adopted by Santiago and West[7] in a recent investigation of lumbang compounds. The lumbang oil was saponified with aldehyde-free alcoholic potassium hydroxide.[8] The mixed potassium soaps thus obtained were converted into the mixed acids. The mixed acids were brominated in ether solution, according to the procedure used by Imperial and West[9] in preparing linolenic hexabromide. The ether solution of mixed acids was stirred mechanically by means of a hot-air motor and brominated at —10° C. The insoluble linolenic hexabromide was removed by filtering. The ethereal filtrate from the hexabromide was treated with sodium thiosulphate solution to remove the bromine, dehydrated with sodium sulphate, and distilled to eliminate the ether. The residue was treated with cold petroleum ether which precipitated a mixture of linolic tetrabromides. The crude solid tetrabromides were separated from the oily (gamma) tetrabromide and oily oleic dibromide by filtering. The crude crystalline tetrabromides were washed with petroleum ether, after which they were crystallized from ethyl alcohol. Two crops of impure alpha linolic tetrabromide (melting point, 110 to 113° C.) were obtained. The crude alpha tetrabromide was washed again with petroleum ether and crystallized once from gasoline and several times from ethyl alcohol. After this further purification the melting point was 112.3 to 114.3° C.

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[6] Beilstein's Handbuch der Organischen Chemie, Vierte Auflage, 2 (1920) 361, 369, 372, 374, 395, 396, 466, 473; Imperial, G. A., and A. P. West, Philip. Journ. Sci. **31** (1926) 441; Almoradie, P. R., and A. P. West, Philip. Journ. Sci. **33** (1927) 257; Oreta, A. T., and A. P. West, Philip. Journ. Sci. **33** (1927) 169.

[7] Philip. Journ. Sci. **32** (1926) 41.

[8] Dunlap, F. L., Journ. Am. Chem. Soc. **28** (1906) 397.

[9] Philip. Journ. Sci. **31** (1926) 44.

Esters of alpha linolic tetrabromide were prepared by first converting the tetrabromide into the acid chloride of alpha linolic acid tetrabromide. The acid chloride was then treated with various alcohols.

Methyl ester of alpha linolic tetrabromide.—Alpha linolic acid tetrabromide (40 grams) was placed in a flask and heated over a wire gauze until the acid was melted completely. Phosphorus trichloride (2.7 cubic centimeters) was poured into a dropping funnel and allowed to drop slowly into the melted tetrabromide. The mixture was then heated for about fifteen minutes, or until the reaction was apparently complete. The acid chloride was then poured off from the viscous phosphorus acid, filtered through glass wool, and the filtrate allowed to drop into a flask containing 20 cubic centimeters of methyl alcohol. The mixture of methyl alcohol and acid chloride was then heated (reflux) on a water bath for about four hours. When cooled in ice water the crude methyl ester separated out as an amorphous mass which had a slightly yellow color. The crude reaction product was then removed by filtering and crystallized four times from methyl alcohol. The purified ester was obtained as a white amorphous powder. The methyl ester melted at 56 to 60° C. The ester was found to be very soluble in the common organic solvents.

Analysis:

	Bromine. Per cent.
Calculated for $C_{19}H_{34}O_2Br_4$	52.09
Found	52.06

Ethyl ester of alpha linolic tetrabromide.—Forty grams of alpha linolic acid tetrabromide were treated with 2.7 cubic centimeters of phosphorus trichloride. The acid chloride thus obtained was filtered through glass wool into a flask containing 20 cubic centimeters of ethyl alcohol. The mixture of chloride and alcohol was heated (reflux) on a water bath for about two hours. The reaction product was then cooled in ice water and the excess of alcohol poured off from the crude ester. After crystallizing several times from methyl alcohol the ester was obtained as white sparkling crystals. The melting point was 58 to 60° C. The ester was very soluble in the usual organic solvents.

Analysis:

	Bromine. Per cent.
Calculated for $C_{20}H_{36}O_2Br_4$	50.93
Found	50.80

Propyl ester of alpha linolic tetrabromide.—Alpha linolic tetrabromide (40 grams) was treated with phosphorus trichloride (2.7 cubic centimeters). The acid chloride thus obtained was filtered and added to 25 cubic centimeters of normal propyl alcohol. The mixture was heated (reflux) over a wire gauze for about three hours; it was then cooled and the precipitated ester separated from the excess alcohol by filtering. The crude ester was crystallized several times from methyl alcohol. The glittering white crystals melted at 45 to 50° C. The ester was very soluble in the common organic solvents.

Analysis:

	Bromine. Per cent.
Calculated for $C_{21}H_{88}O_2Br_4$	49.82
Found	49.66

Isopropyl ester of alpha linolic tetrabromide.—Alpha linolic tetrabromide (15 grams) was treated with 0.93 cubic centimeter of phosphorus trichloride. The acid chloride was filtered through glass wool and added to 20 cubic centimeters of isopropyl alcohol. The mixture was heated (reflux) on a water bath for about four hours. The reaction product was then cooled in ice water and the excess of alcohol removed by filtering. The crude ester was crystallized several times from methyl alcohol. The melting point was 50 to 52° C. The ester was very soluble in the usual organic solvents.

Analysis:

	Bromine. Per cent.
Calculated for $C_{21}H_{38}O_2Br_4$	49.82
Found	49.53

Allyl ester of alpha linolic tetrabromide.—The method used for preparing this ester was quite similar to the procedure employed in making the isopropyl ester. Fifteen grams of alpha linolic tetrabromide were treated with 0.93 cubic centimeter of phosphorus trichloride. The acid chloride was filtered through glass wool and added to 15 cubic centimeters of allyl alcohol. The mixture was heated (reflux) over a wire gauze for about eight hours. When cooled in ice water the reaction product separated out as a brown precipitate which was somewhat sticky. The excess alcohol was poured off and the crude ester crystallized several times from methyl alcohol. After purification the ester was obtained as an amorphous mass which was still slightly yellow. The melting point was 72 to 80° C. The ester was very soluble in benzene, chloroform, ethyl benzoate, toluene, and xylene. When treated with acetone, ether, ethyl alcohol, ethyl acetate, propyl alcohol, and petroleum ether the ester formed turbid solutions and did not dissolve completely.

Analysis:

	Bromine. Per cent.
Calculated for $C_{21}H_{36}O_2Br_4$	49.98
Found	49.93

SUMMARY

A considerable quantity of alpha linolic acid tetrabromide (melting point, 112.3 to 114.3° C.) was made from lumbang oil.

The acid chloride of alpha linolic acid tetrabromide was prepared by treating alpha linolic acid tetrabromide with phosphorus trichloride.

Esters of alpha linolic acid tetrabromide were obtained by the interaction of the acid chloride and various alcohols.

The following esters were prepared: Methyl, ethyl, propyl, isopropyl, and allyl.

The melting points of these esters and their solubility in various solvents were determined.

NOTE ON FRAMBŒSIA IN SUMATRA [1]

By B. M. VAN DRIEL

Of the Hospital Soengei, Sengkol, Medan, Sumatra

HOSPITAL SOENGEI, SENGKOL,
Medan, Sumatra, 8 April, 1927.

Dear Dr. LOPEZ-RIZAL: In the Philippine Journal of Science for August, 1926, I read the interesting papers on Frambœsia.

On page 498 I see the statement of Winckel quoted, who stated in his article on Yaws in the Meded. v. d. Borgerl. Geneesk. Dienst in Ned. Indië 1923, 213, that "in Sumatra many cases are found at a height of 3,000 feet."

Winckel says these cases do occur on the plateaus in the Batak lands. He himself has never resided there but has the statement only from other medical officers, who told him that in the Batak countries, especially among the tribe of the Karo Bataks, yaws was very frequent; but, on account of not being personally acquainted with the geographic situation, he did not know that a great many of the Karo Bataks are not living on the plateau but in the countries on the slopes of the mountains, which are much lower, some of the Batak kampongs being situated at not more than 60 or 100 meters above sea level.

From personal experience (I lived for nearly three years on the Batak plateau) I can assure you that there frambœsia is quite as rare as it is in Java at this altitude. I saw only some ten or twenty cases, most of them of a somewhat different type from that seen in the lowlands and rather a large percentage with tertiary lesions. I was on the Batak plateau from 1920 until 1923. Some years earlier the well-known Professor Schuffner also made a survey of the plateau and, according to many personal oral communications to me, he also thought frambœsia to be extremely rare there.

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[1] In August, 1926, there appeared in the Philippine Journal of Science an article by Dr. L. Lopez-Rizal and Dr. A. W. Sellards on frambœsia, in which they quoted a statement by Winckel. In April, 1927, Dr. Lopez-Rizal received a letter from Dr. B. M. Van Driel in regard to this quotation. Doctor Van Driel expressed the desire that this letter be published. The letter, which is self-explanatory, is here reproduced, with some slight editorial corrections.—EDITOR.

Some time ago I met Doctor Winckel in Java and told him what I thought about his statement. He agreed with me that he had no personal acquaintance with the question and had understood from his conversation with Doctor Schuffner what he communicated to the papers. It was, however, too late to revoke the statement as it had already appeared in the Trop. Dis. Bull. and so in the international literature.

In a paper on account of the sixtieth anniversary of Professor Schuffner which appeared in our journal I had the occasion to try to eradicate Doctor Winckel's statement which really is wrong.

I am, sir,

Yours faithfully,
B. M. VAN DRIEL.

FIFTH REPORT UPON DIPTERA PUPIPARA FROM THE PHILIPPINE ISLANDS

By G. F. FERRIS
Of Stanford University, California

NINETEEN TEXT FIGURES

The material upon which this, the fifth, report upon the Diptera pupipara of the Philippine Islands is based has been received at various times from Mr. R. C. McGregor. In addition Mr. P. A. Buxton has permitted me to include certain species collected by him in the New Hebrides, all of which have some bearing upon the Philippine material. Altogether, fourteen species are here dealt with, all in the family Hippoboscidæ; five of these are described as new.

Genus ORNITHOICA Rondani

In the fourth paper of this series I dealt with this genus and recorded a single species from the Philippine Islands. It is now possible to add three more species to the list as well as further records of the first species.

ORNITHOICA PROMISCUA Ferris and Cole.

Ornithoica promiscua Ferris and Cole, FERRIS, Philip. Journ. Sci. **28** (1925) 331, figs. 1 and 2.

Present records.—From *Leucotreron leclancheri* Bonaparte, *Centropus sinensis* (Stephens), and *Pitta atricapilla* Lesson, Puerto Princesa, Palawan; and from *Batrachostomus microrhynchus* Grant, Limay, Bataan Province, Luzon, all collected by R. C. McGregor; from *Ceyx melanura* Kaup, Alabat Island, Tayabas Province (*F. Rivera*).

ORNITHOICA PUSILLA (Schiner). Fig. 1.

Ornithomyia pusilla SCHINER, Reise Novara 374 (1868).

Ornithoica pusilla (Schiner), SPEISER, Ann. Mus. Civico (2a) **20** (1901) 559.

Ornithoica pusilla (Schiner), SPEISER, Zeitsch. f. Hym. u. Dipt. **4** (1904) 86.

Ornithoica confluenta (Say), ALDRICH, Ins. Inscit. Menstruus **11** (1923) 79 (part).

Previous records.—Recorded by Schiner from *Halcyon veneratum* in Tahiti. Speiser (1904) records under this name specimens from *Pitta vigorsi* from Christmas Island. Aldrich records specimens (as *O. confluenta*) from *Halcyon* sp., Philippine Islands, which on the basis of hosts might well be this species.

In another paper, now in press, I am recording the species from the New Hebrides and Samoa from *Halcyon juliae* and *Aplonis atrifusca.*

Present record.—A male from Puerto Princesa, Palawan, September 6, 1926 (*McGregor*), host recorded as in doubt, being either *Spilopelia* sp., *Caprimulgus* sp., or *Syrnium* sp.; and a male from *Astur* sp., San Andales, Rizal Province, Luzon (*Rivera*).

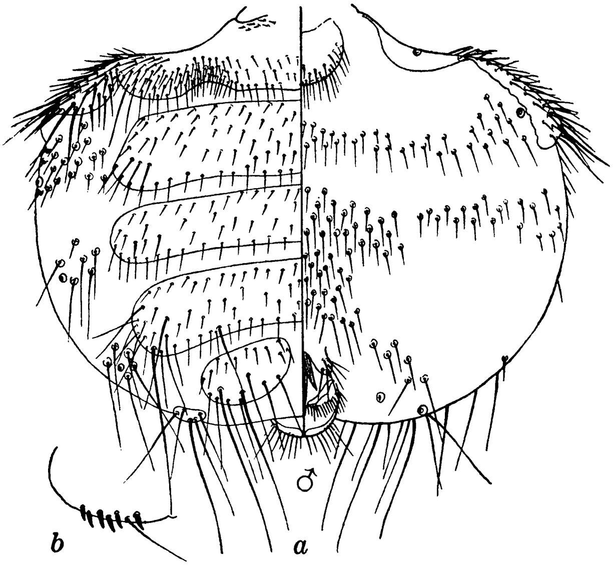

FIG. 1. *Ornithoica pusilla* (Schiner) ; *a*, abdomen of male ; *b*, posterior margin of posterior trochanter.

Notes.—Two specimens from the Philippines agree exactly with the specimens from the New Hebrides and Samoa. I have identified the latter as *O. pusilla* solely upon the basis of the community of hosts of the genus *Halcyon* and the correspondence in general locality. It must be emphasized that this identification is merely a guess, the demonstrated fact that two perfectly distinct species of this genus may occur upon the same host species in the same locality reducing the value of determinations made upon these bases practically to zero. There is nothing in the existing literature which would make a more positive determination possible.

The species is almost identical in size and characters of the head, thorax, and wings with *O. promiscua;* so much so that for these parts of the body the figures previously given for the latter species will serve equally well for *O. pusilla.* The two species differ, however, very markedly in other respects.

The trochanters of the posterior legs in *O. pusilla* (fig. 1, *b*) bear upon their posterior margin a series of short, stout, black setæ which are not present in *O. promiscua.* The abdomen (fig. 1, *a*) bears but three transverse tergal plates in addition to the usual basal plate and paired apical plates, while in *O. promiscua* there are four of these transverse plates. The ventral side of the abdomen lacks the very conspicuous chitinous tubercles which are conspicuous features of the latter species.

Ornithoica pusilla is very similar to a species which I have redescribed as *O. beccariina* Rondani, from Borneo, in a paper now in press in the Sarawak Museum Journal. The latter species, however, lacks the black setæ on the posterior trochanters.

ORNITHOICA UNICOLOR Speiser. Fig. 2.

Ornithoica unicolor. SPEISER, Ann. Mus. Civico (2a) 20 (1901) 556.

Previous records.—Recorded only from Sumatra, without indication of host.

Present record.—A single mutilated specimen from *Penelopides manillæ* (Boddaert), Isabela Province, Luzon, February 15, 1926 (*G. Taguibao*).

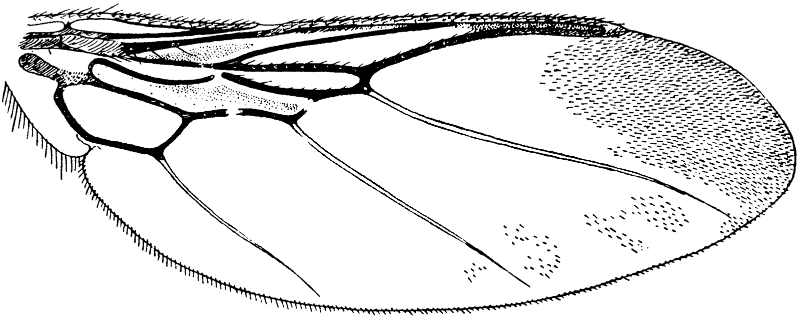

FIG. 2. *Ornithoica unicolor* Speiser; wing.

Notes.—The original description of *O. unicolor* is entirely worthless except that it notes the unusual size—for this genus —of the species. The length, based upon a dried specimen, is given as 3.5 millimeters, and the length of the wing as 4 millimeters. With these measurements the single specimen at hand agrees closely and, as no other species of similar size is known, there is a reasonable chance that the identification is correct.

Unfortunately, the single specimen has the abdomen so badly mutilated that it cannot be definitely reconstructed and I am therefore leaving the description of the body for some future time, hoping to secure adequate material. The wings, however, are complete and I am here figuring them (fig. 2). It will be noted that they differ strikingly from the wings of *O. promiscua*—with which all the other available species agree very closely—in the distribution of the vestiture of minute setulæ. In *O. unicolor* these setulæ are confined to very small areas near the extreme apex of the wings. This alone is sufficient to mark the species.

ORNITHOICA PHILIPPINENSIS sp. nov. Fig. 3.

Specimens examined.—A single male from *Ceyx melanura* Kaup, Alabat Island, Tayabas Province, Philippine Islands (*Rivera*).

Male.—Length on slide, 2.25 millimeters; length of wing, 2.5. In the characters of head, thorax, and wings apparently identical with the common type of the genus as previously figured and described in detail for *O. promiscua,* differing from this type in the following respects:

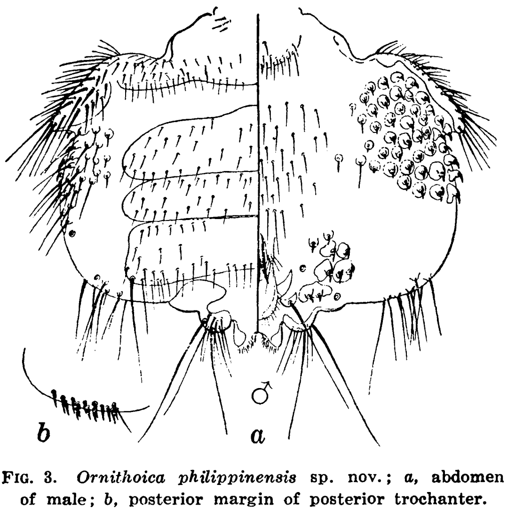

FIG. 3. *Ornithoica philippinensis* sp. nov.; *a*, abdomen of male; *b*, posterior margin of posterior trochanter.

Trochanters of posterior legs (fig. 3, *b*) with a series of short, stout, black setæ on the posterior border, as in *O. pusilla.* Posterior tibiæ apparently without a spur at the inner apex.

Abdomen (fig. 3, *a*) with the usual basal tergite and with two subapical plates and, in addition to these, but three transverse tergal plates, as in *O. pusilla* and *O. beccariina.* Ventral side with numerous, large and conspicuous, heavily chitinized tubercles, each bearing one or more short, stout setæ, the species differing in this respect from *O. pusilla* and *beccariina.*

Notes.—This species is evidently quite distinct from any of the other species that are available. If my identifications are correct, *O. turdi* (Latreille) and the evidently very similar *O. promiscua* Ferris and Cole, *O. pusilla* (Schiner), *O. unicolor* Speiser, and *O. beccariina* Rondani may be eliminated. There remain *O. confluenta* (Say) from North America, *O. exilis* (Walker) from New Guinea, *O. podicipis* von Röder from East Africa, *O. stipituri* (Schiner) from Australia, and *O. vicina* (Walker) from Jamaica to be considered. It is impossible to hazard even a guess as to which, if any, of these it might possibly be.

Genus ORNITHOMYIA Latreille

This genus, once inclusive of a large proportion of the Hippoboscidæ, is now restricted to a relatively small number of forms with the following assemblage of characters. Wings present, functional, noncaducous, having several veins in addition to the costa, these including three "cross veins" and consequently with an "anal cell," the "third vein" (R_{4+5}) not confluent with the costa. Ocelli present. Claws three-toothed. Antennæ elongate, slender, tapering toward the apex and more or less divergent. Abdomen without an area of minute, transverse striations on the dorsum.

Type of the genus, *Hippobosca avicularia* Linnæus.

This genus has in the past been regarded as a very large one but, with its comparatively recent dismemberment and the distribution of many of its species to the genera *Ornithoctona, Ornitheza,* and *Ornithopertha,* it retains but a small number of forms. There is evidently much confusion within the group and the status of the various forms still remaining within the genus is doubtful. In the Philippine material there is represented a single species which I am referring doubtfully to a named form.

I have elsewhere indicated that the absence of a ctenidium or the first segment of the posterior tarsi would aid in separating this genus from *Ornithoctona.* Material now available indicates that this character is not of generic significance.

ORNITHOMYIA AVICULARIA (Linnæus) ? Figs. 4 and 5.

Ornithomyia avicularia (Linnæus), MASSONAT, Ann. Univ. Lyon N. S. (1) 28 (1909) 271–278, pl. 4, figs. 33 and 34.

Ornithomyia avicularia (Linnæus), FERRIS and COLE, Parasitology 14:199, 200, figs. 15 and 16.

Previous records.—If the existing records are to be accepted as valid, this is a widely distributed species, occurring on birds of many genera and species in Europe, North and South America, New Zealand, and Australia.

Present record.—A single female from *Anthus gustavi* Swinhoe, Puerto Princesa, Palawan, Philippine Islands, October 9, 1925 (*McGregor*).

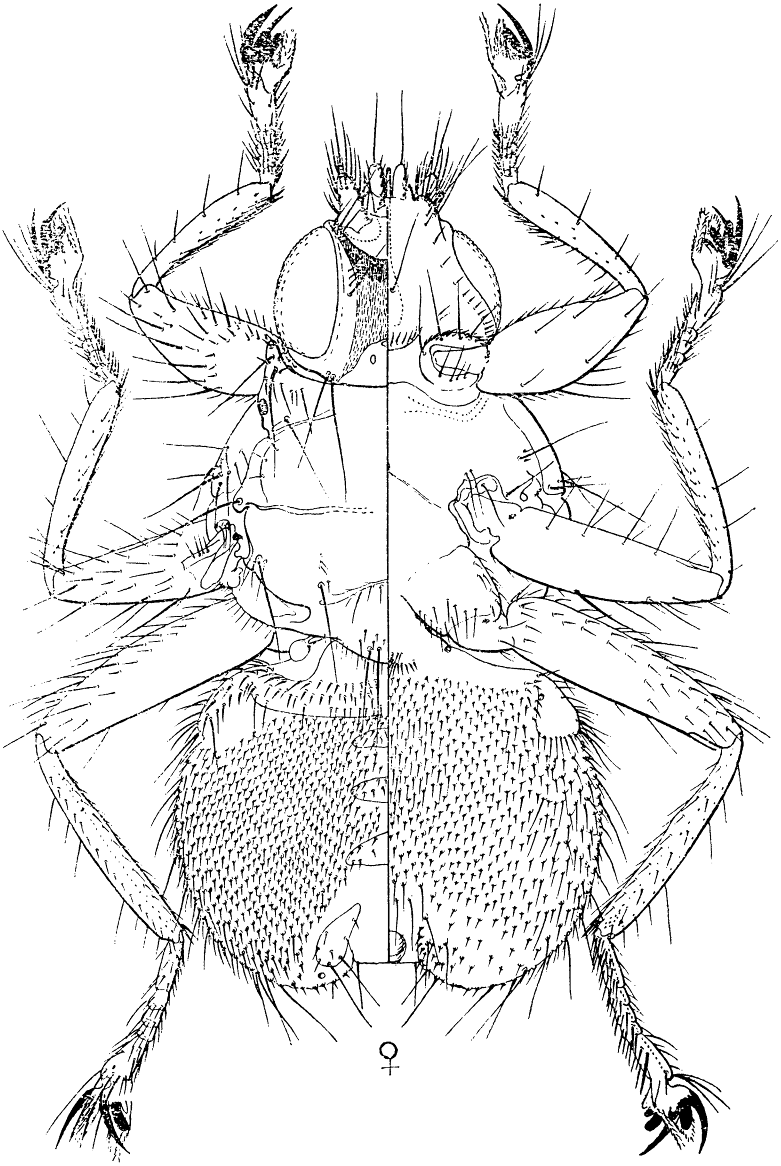

FIG. 4. *Ornithomyia avicularia* (Linnæus) ?; female, wings removed. From a specimen from *Anthus guslavi* Swinhoe, Philippine Islands.

Notes.—I do not have available authentic European material representing this species, but the single Philippine specimen agrees exactly with specimens from western United States which I have considered to be *O. avicularia.* It also agrees with almost equal precision with specimens from the oystercatcher in England determined by Austen as *O. lagopodis* Sharp.

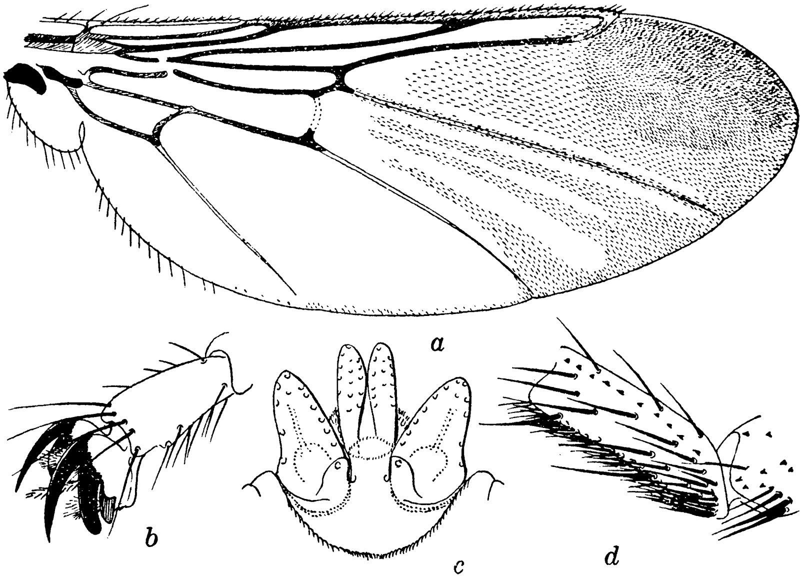

FIG. 5. *Ornithomyia avicularia* (Linnæus) ?; *a*, wing; *b*, claws; *c*, clypeal region of head; *d*, first segment posterior tarsus. From the same specimen as fig. 4.

The accompanying figures should make the identification of the species simple and I add only the following notes. Length, on slide, 5 millimeters; of wing, 5. The wing (fig. 5, *a*) shows the setulæ arranged in a characteristic pattern, which is quite constant throughout all the specimens examined. The darker area near the apex of the wing is caused by the fact that here the setulæ are present on both surfaces, while elsewhere they are confined to one side.

Genus ORNITHEZA Speiser

This genus has been dealt with in an earlier paper of this series.

ORNITHEZA METALLICA (Schiner). Fig. 6.

Ornitheza metallica (Schiner), FERRIS, Philip. Journ. Sci. 27 (1925) 419, 420, figs. 4 and 5.

Present record.—A single male from *Merops americanus* P. L. S. Müller, Casiguran, Tayabas Province, Luzon, Philippine

Islands (*Rivera*). In another paper, now in press elsewhere, I am recording the species from *Aplonis brevirostris* in Samoa and *Halcyon juliae* in the New Hebrides.

Notes.—In my earlier notes on this species the female alone was available. The male resembles the female very closely in all the characters of head, thorax, and wings, but differs markedly in the abdomen.

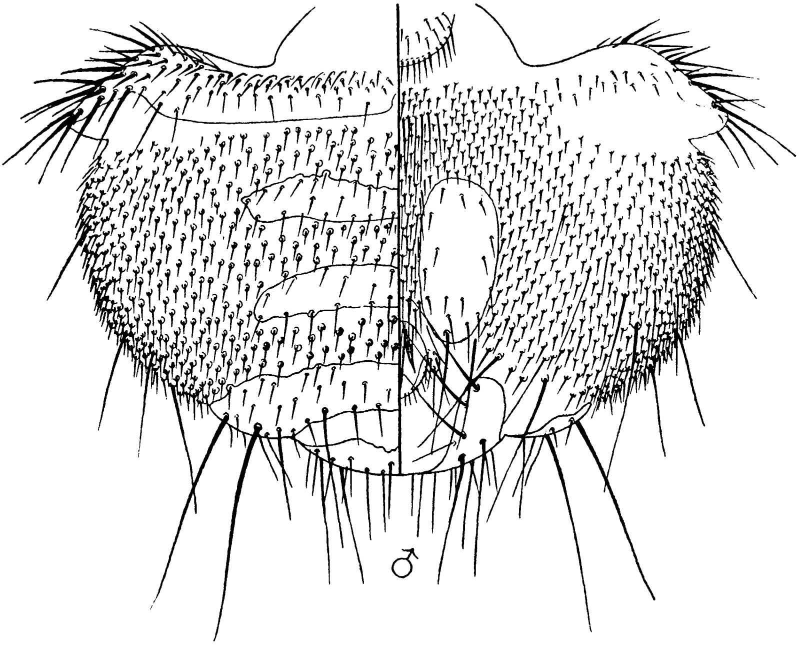

FIG. 6. *Ornitheza metallica* (Schiner); abdomen of male.

The abdomen (fig. 6) bears, in addition to the basal tergite, two rather large plates which extend across the mesal third of its width, these followed by a third plate which extends entirely across the abdomen, and also by an apical plate which extends to the ventral aspect. On the ventral side, just anterior to the genital opening, are a pair of oval plates, one on each side of the median line. Except for the plates, the entire abdomen is membranous and is thickly beset with short setæ, which are borne upon small prominences. The apical and preapical plates bear several long setæ as indicated in the figure.

The single Philippine specimen differs slightly from the one male available from Samoa, having the tergal plates somewhat narrower; but the females agree entirely and there seems no reason to believe that more than one species is involved.

Genus ORNITHOCTONA Speiser

In an earlier paper of this series, I discussed this genus and recorded one species from the Philippine Islands. This species appears again in the material at hand.

ORNITHOCTONA NIGRICANS (Leach). Figs. 7 and 8.

Ornithomyia nigricans LEACH, Mem. Wernerian Nat. Hist. Soc. **2** (1818) 558, figs. 7 to 10.

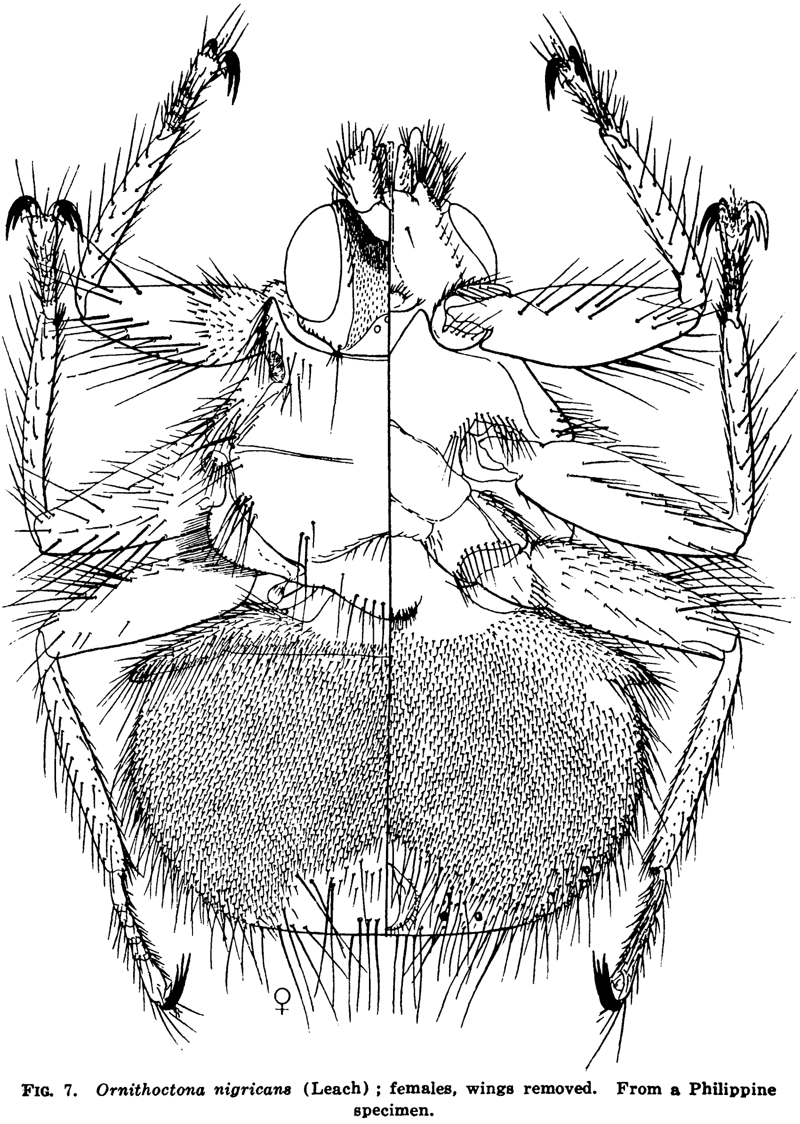

FIG. 7. *Ornithoctona nigricans* (Leach); females, wings removed. From a Philippine specimen.

Ornithomyia (*Ornithoctona*) *nigricans* (Leach), AUSTEN, Ann. & Mag. Nat. Hist. VII 12 (1903) 263.

Ornithoctona nigricans (Leach), SPEISER, Ann. Mus. Civico Genova (3) 1 (1905) 338 to 343.

Ornithoctona magna FERRIS, Philip. Journ. Sci. 28 (1925) 339 (without description).

Ornithoctona magna FERRIS, Sarawak Mus. Journ. (in press).

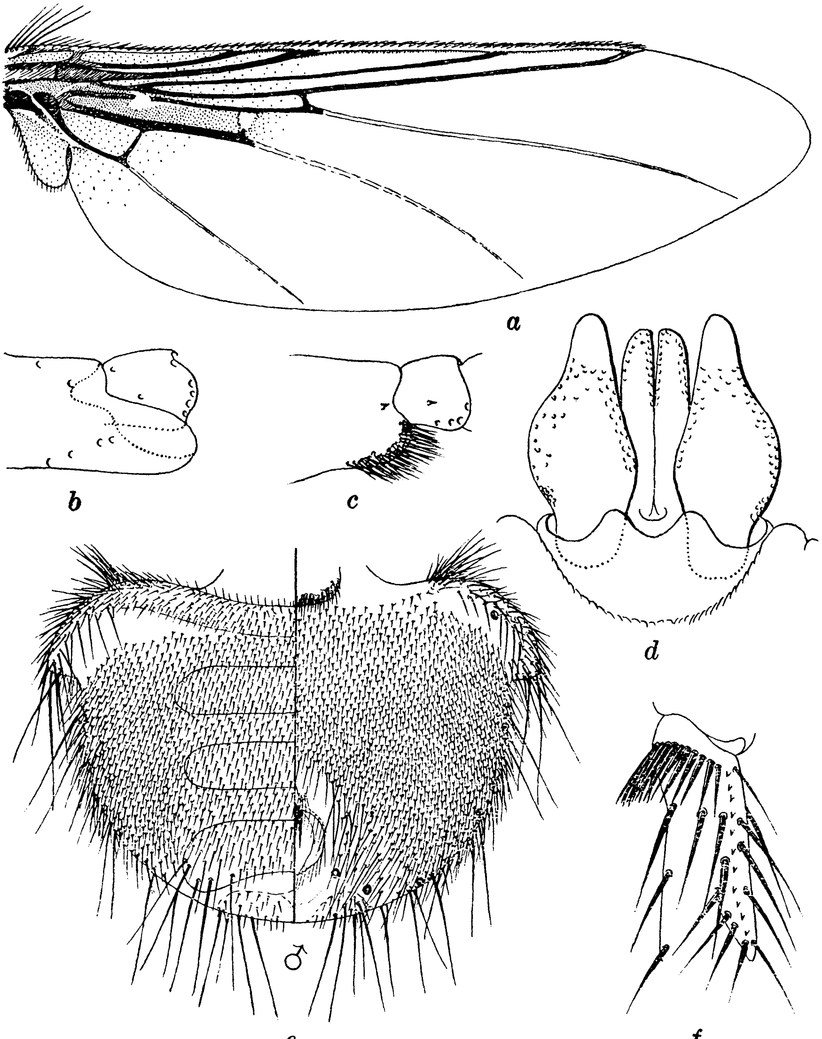

FIG. 8. *Ornithoctona nigricans* (Leach); *a*, wing; *b*, apex of anterior tibia of female; *c*, apex of anterior tibia of male; *d*, clypeal region; *e*, abdomen of male; *f*, first segment of posterior tarsus.

Previous records.—A widely distributed species on many hosts in the Oriental and southern Pacific regions. Recorded from the Philippine Islands by Speiser, and by Ferris as *O. magna*.

Present records.—From *Circus wolfi*, Tanna, New Hebrides (*P. A. Buxton*) and from the Philippine Islands as follows: *Haliastur intermedius* Gurney, Manila (*McGregor*); *Calisitta œnochlamys* (Sharpe) and *Oriolus albiloris* Grant, San Mariano, Isabela Province, Luzon (*Taguibao*); *Chalcophaps indica* (Linnæus), Limay, Bataan Province, Luzon (*McGregor*); *Muscadivores palawanensis* (Blasius), *Astur* sp., *Thriponax hargitti* Sharpe, *Corvus pusillus* Tweeddale, *Spilopelia tigrina* (Temminck and Knip), and *Dendrophassa vernans* (Linnæus), all from Puerto Princesa, Palawan (*McGregor*); *Phapitreron amethystina* Bonaparte and *Lichtensteinipicus funebris* (Valenciennes), Lucban, Tayabas Province, Luzon (*Rivera*); *Artamides striatus* (Boddaert), Burgos, Ilocos Sur Province, Luzon (*Rivera*); *Artamus leucorynchus* (Linnæus) and *Leucotreron leclancheri* Bonaparte, Casiguran, Tayabas Province, Luzon (*Rivera*); *Dryococcyx harringtoni* Sharpe, Palawan (*McGregor*); *Penelopides manillae* (Boddaert), San Andales, Rizal Province, Luzon (*Rivera*).

The description of this species as *Ornithoctona magna* has been in press nearly two years in the Sarawak Museum Journal. On the basis of material from Samoa and the New Hebrides identified by Mr. G. E. Bryant, probably by comparison with the types in the British Museum, I am placing *O. magna* as a synonym of *O. nigricans* (Leach). Speiser (cited above) has indicated a long series of names as probably being synonyms of this species and has recorded the species from the Philippine Islands.

This is an extremely large species, the female measuring as much as 12 millimeters on the slide, with a wing length of 10.5 to 11 millimeters. The male is smaller, attaining only 8 to 9 millimeters, with the same length of wing. The females vary noticeably in size, but the wing length remains very constant.

In pinned specimens the species appears practically black, but in alcoholic material it is of a general gray-brown color.

The female (fig. 7) differs from other species of the genus that are available in the complete absence of tergal plates on the abdomen and in having the apex of the anterior tibiæ (fig. 8, *b*) produced on the inner side into a lamellate process that almost incloses the first tarsal segment.

The male differs from the female chiefly in having three large tergal, abdominal plates (fig. 8, *e*) and in lacking the lamellate process on the anterior tibiæ, this being replaced by a tuft of small setæ (fig. 8, *c*).

The wing (fig. 8, *a*) is entirely devoid of setulæ.

Genus MYIOPHTHIRIA Rondani

Myiophthiria FERRIS, Philip. Journ. Sci. 28 (1925) 336.
Myiophthiria AUSTEN, Parasitology 18 (1926) 359.

I discussed this genus in an earlier paper of this series. A further discussion will be found in the paper of Austen, cited above. In all, three species have been recorded in the genus, but of these one, *M. capsoides* Rondani, has been placed by Speiser as a synonym of *M. reduvioides* Rondani. The former was originally described from the Philippine Islands. On the basis of the notes given by Austen it would appear that certain specimens which are at hand from the New Hebrides definitely represent *M. reduvioides* and, if Philippine material should be regarded as belonging to a distinct species, they may be regarded as *M. capsoides*. There are slight differences between the New Hebridean and the Philippine material, as indicated below, but I am not disposed to consider that more than one species is involved.

To my earlier notes there should be added the statement that the posterior tarsi bear at the base of the first segment a transverse comb of setæ, similar in all respects to that which is found in the genus *Ornithoctona* and sometimes in *Ornithomyia*.

MYIOPHTHIRIA REDUVIOIDES Rondani. Fig. 9.

Myiophthiria reduvioides Rondani, FERRIS, Philip. Journ. Sci. 28 (1925) 337, 338, fig. 5.

Present record.—Two males and two females from *Collocalia francica vanicorensis*, Hog Harbor, New Hebrides (*Buxton*).

Notes.—In my earlier discussion of this species the female alone could be redescribed. The material now available contains both males and females. The females from the New Hebrides differ from the single female from the Philippine Islands only in the character of the tergal plates of the abdomen. In the former there are two median plates in addition to the paired apical plates, while in the latter there is but one median plate; furthermore, all the plates are larger in the

New Hebridean specimens. The difference, however, is not very great and I am not inclined to regard it as especially significant.

The male differs from the female, as previously described and figured by me, only in the characters of the abdomen (fig. 9). There are three transverse tergal plates, in addition to the apical pair, the third of these reaching almost entirely across the abdomen. The external genitalia are very inconspicuous, the claspers being extremely minute.

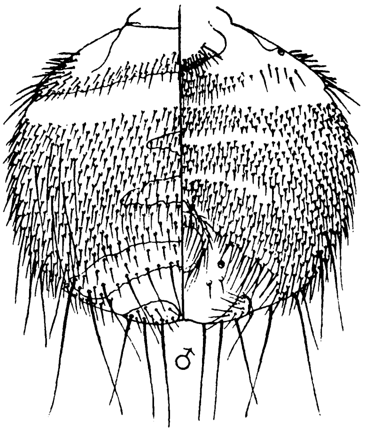

FIG. 9. *Myiophthiria reduvioides* Rondani; abdomen of male. From a specimen from the New Hebrides.

Genus PSEUDOLYNCHIA Bequaert

Lynchia Weyenberg, FERRIS, Philip. Journ. Sci. 27 (1925) 415.
Pseudolynchia BEQUAERT, Psyche 32 (1926).

Bequaert has critically examined the description of *Lynchia penelopes* Weyenbergh, which is the type of the genus, and has concluded that it does not belong with the species with which it has commonly been associated but with the group for which the name *Ornithoponus* is now employed. For the species thus left without a generic name he has proposed the name *Pseudolynchia,* with the former *Lynchia maura* (Bigot) as type.

PSEUDOLYNCHIA MAURA (Bigot).

Lynchia maura (Bigot), FERRIS, Philip. Journ. Sci. 27 (1925) 416, 417, figs. 2 and 3.

Present record.—A single female from *Spilopelia tigrina* (Temminck and Knip), Puerto Princesa, Palawan, Philippine Islands (*McGregor*).

Notes.—My previous record of this species from the Philippine Islands was based upon the comparison of a single male with a female from Europe. The female from the Philippines which is now at hand confirms the identification, agreeing very closely with the European specimen.

The species has previously been recorded only from pigeons, and it may be noted that the present host record has to do with a bird of the same family.

Genus OLFERSIA Wiedemann

Pseudolfersia of authors.

This genus, which is probably to be regarded as sufficiently distinct from *Lynchia* (*Olfersia* of authors, *Ornithoponus, Icosta*), is definable by the following group of characters. Wings present, functional, noncaducous, with several veins behind the costa, with two "cross veins," rm and m_3, present and consequently with an "anal cell;" abdomen with a median dorsal area of transverse striations; claws three-toothed; ocelli absent; clypeus elongate, being nearly one-half the length of the head and deeply cleft by a narrow median incision; pleurotergite of the mesothorax with a nipplelike protuberance.

The type of the genus is *Feronia spinifera* Leach.

The nomenclatorial permutations through which the name *Olfersia* has come to be applied to this group rather than to the much larger group of species with which it was formerly associated have been sufficiently explained by Aldrich.

OLFERSIA SPINIFERA (Leach). Figs. 10 and 11.

Pseudolfersia spinifera (Leach), FERRIS and COLE, Parasitology 14 (1922) 196 to 198, figs. 13 and 14.

Olfersia spinifera (Leach), ALDRICH, Ins. Inscit. Menstruus 11 (1923) 78.

Previous records.—This species has many times been recorded from various parts of the Tropics as a parasite of the frigate bird *Fregata aquila* (Linnæus). Ferris and Cole have considered that *Olfersia diomedeae* (Coquillet) from *Diomedea irrorata* on the Galapagos Islands, and *O. vulturis* Van der Wulp, from vultures in Central and South America, are synonyms.

Present records.—Males and females from *Fregata aquila* (Linnæus), Cavili Island, Philippine Islands (*W. Schultze*) and a single female from Laysan Island from "wedge-tailed shearwater."

Notes.—The species is very well known and needs no extended description here. The accompanying figures should make its identification simple. However, the forms associated with this species present something of a problem. I have, in company with F. R. Cole, considered that *O. diomedeae* (Coquillet) and *O. vulturis* Van der Wulp are synonyms of *O. spinifera,* but a review of the material upon which my conclusions were based and a study of further material raises some doubt as to the correctness of this view.

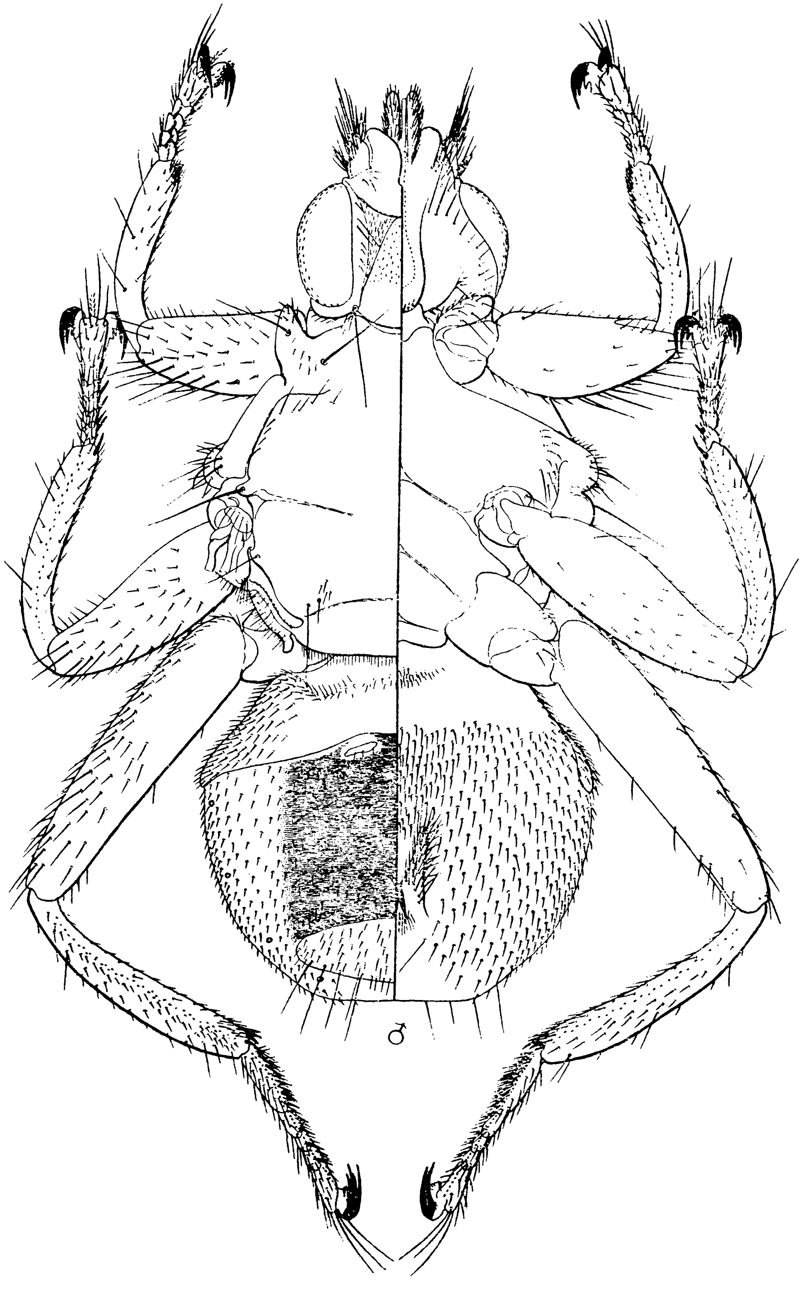

FIG. 10. *Olfersia spinifera* (Leach); male, wings removed. From a Philippine specimen from *Fregata aquila* (Linnæus).

All of these forms are very similar, indeed, as far as their general characters are concerned. There is evidently some variation in individuals which may reasonably be regarded as belonging to the same species, for specimens from the frigate bird at Cape San Lucas, Lower California, differ from the Philippine specimens in having the posterior margin of the head much more deeply lobed, and the vertex more produced posteriorly. Also, they differ in having a small but distinct patch of setulæ on the anal area of the wing, which is entirely bare in the Philippine specimens.

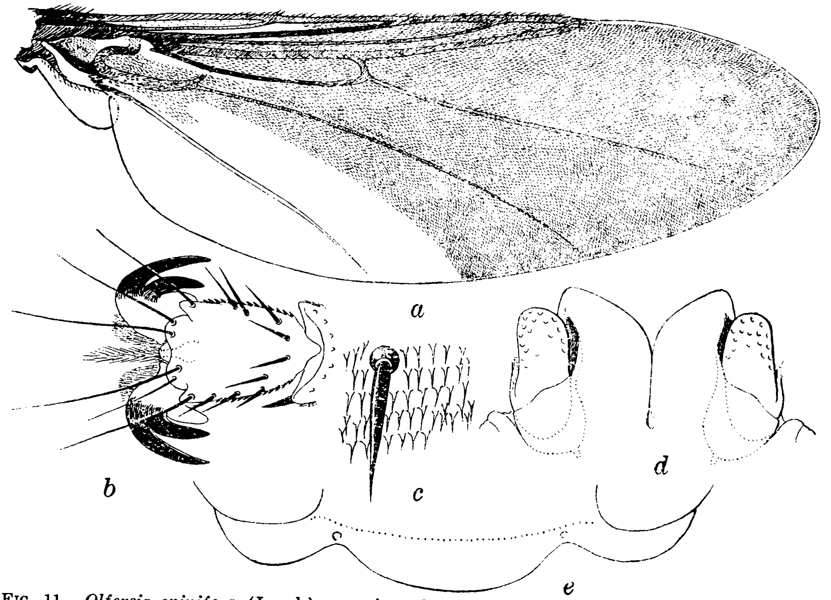

FIG. 11. *Olfersia spinifera* (Leach) ; *a*, wing ; *b*, claws ; *c*, portion of derm of abdomen ; *d*, clypeal region ; *e*, posterior margin of head. From the same specimen as fig. 10.

A paratype specimen of *O. diomedeae* agrees with the specimen from the shearwater on Laysan Island in having part of the anal area, which is bare in the Philippine specimens, covered with setulæ on one side of the wing only, the remainder of the wing bearing setulæ on both sides.

Specimens from vultures in Central and South America agree in having the posterior margin of the head slightly less deeply lobed than do the Philippine specimens and in having the nipple-like prominence of the pleurotergite noticeably longer. They agree with the Philippine specimens in the characters of the wings.

It appears, then, either that there is a single variable species or that possibly several closely related forms are involved. The examination of a long series of specimens from various hosts and localities may serve to clear up the problem.

Genus LYNCHIA Weyenbergh

Lynchia WEYENBERGH, Anal. Soc. Cientif. Argent. 11 (1881).
Icosta SPEISER, Zeitsch. f. syst. Hymenopterologie und Dipterologie 5 (1905) 358.
Ornithoponus ALDRICH, Ins. Inscit. Menstruus 11 (1923) 78.
Ornithoponus FERRIS, Philip. Journ. Sci. 28 (1925) 332.
Lynchia BEQUAERT, Psyche 32 (1925).
Olfersia of most authors.

Bequaert has recently examined the status of certain species and has arrived at the conclusion that *Lynchia penelopes* Weyenbergh, which is the type of its genus, is congeneric not with the forms with which it has usually been associated but with those which have usually been included under the genus *Olfersia;* in other words, with that genus of which *Feronia americana* Leach is commonly accepted as the type. Aldrich has previously called attention to the nomenclatorial accident which makes necessary the transfer of the generic name *Olfersia* to the genus that has commonly been called *Pseudolfersia,* this transfer apparently leaving the group of *americana* without a name. For this group he proposed the new name *Ornithoponus,* with *americana* as the type.

Accepting Bequaert's view as to the generic position of *Lynchia penelopes* it becomes evident that the name *Ornithoponus* is a synonym of *Lynchia.* The name could not have stood, anyway, for it seems evident that it was antedated also by *Icosta* Speiser. In an earlier paper of this series, I called attention to a suspicion that these two genera cannot be separated unless some characters other than those given by Speiser for *Icosta* can be found. The material now available changes this suspicion to a definite conviction that *Icosta* must also be placed as a synonym of *Lynchia.*

The genus *Icosta* of Speiser was based solely upon the character of the clypeus, which is described as deeply emarginate, its arms projecting like horns about the base of the antennæ. Certain specimens here to be dealt with show this character very strongly developed, but the examination of a series of specimens shows the impracticality of attempting to separate these species generically from *Lynchia,* at least as represented by *americana.* There is, in fact, no essential difference.

I have previously called attention to my belief that most of the named species of this genus are unrecognizable on the basis of the descriptions. The accompanying figures, representing four species, will show how close is the similarity of general form and the nature of the characters which must be known and utilized for any definite specific separation. With the exception of a few forms, such as *L. sarta* (Ferris), which I have described in an earlier paper of this series, there is a very close adherence to a fixed general type. I am convinced that attempts to separate species on the basis of the usual pinned material can lead to nothing but confusion. It is not at all improbable that of the four species here described as new at least some are named forms.

LYNCHIA TUBERCULATA sp. nov. Figs. 12 and 13.

Specimens examined.—A single male from *Corvus pusillus* Tweeddale, Puerto Princesa, Palawan, Philippine Islands, August 9, 1925 (*McGregor*).

Male (fig. 12).—Length on slide, 4.5 millimeters; length of wing, 4.5.

Head with the clypeus (fig. 13, *b*) produced on each side into a tapering, hornlike process which much exceeds the antenna; vertical triangle (fig. 13, *c*) with a slight emargination and incision in the anterior margin.

Thorax with the humeral angles (humeral callosities) prominent and rather slender. Legs with no specially distinctive characters. Wings (fig. 13, *a*) with the venational type common to the genus, their entire surface beset with minute setulæ, excepting only the area behind the anal vein, this vein itself, and vein $M_3 + Cu$.

Abdomen with a single small tergal plate immediately caudad of the basal tergite and with a complete apical tergite. Over the membranous portions of the abdomen are numerous small, slender setæ, those in the lateral areas being borne upon pronounced chitinous tubercles.

Notes.—The combination of characters enumerated will distinguish this species definitely.

LYNCHIA SETOSA sp. nov. Figs 14 and 15.

Specimens examined.—One male, the holotype, from *Bubulcus coromandus* (Boddaert), Palawan (*McGregor*); and a single female, the allotype, from the same host species, Lucban, Tayabas Province, Philippine Islands (*McGregor*).

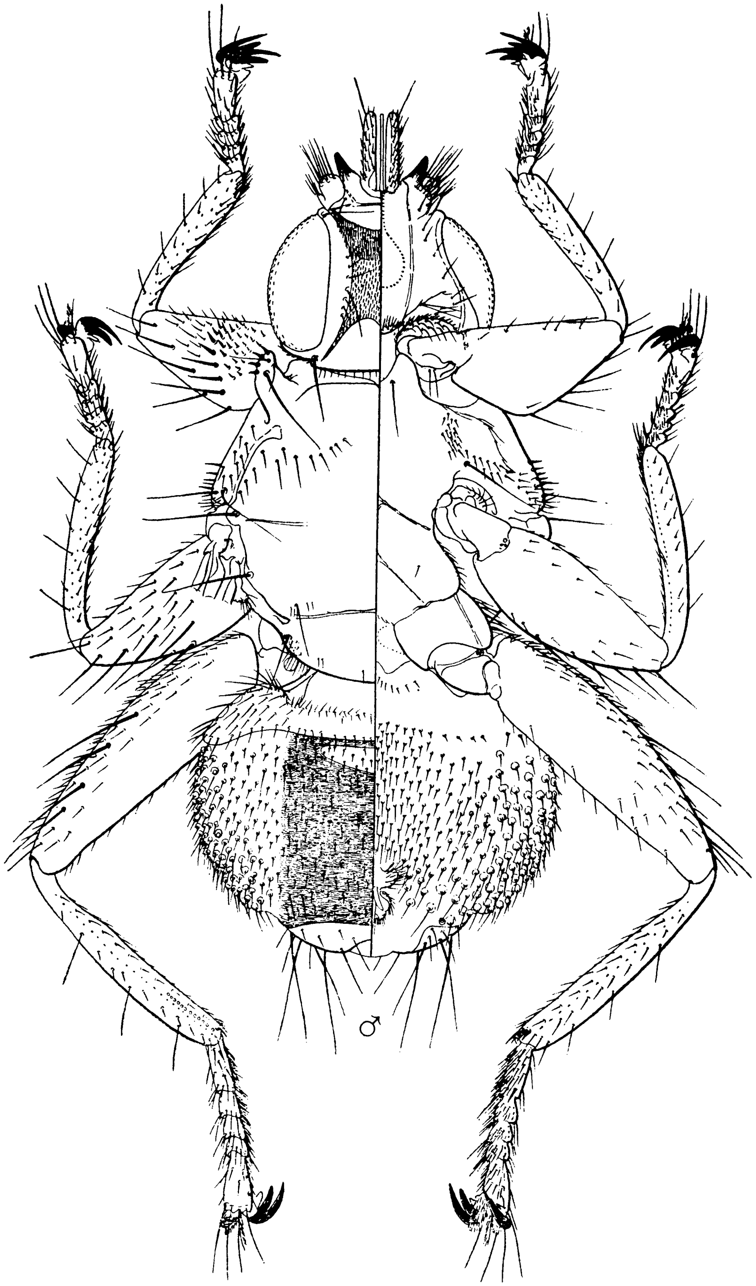

FIG. 12. *Lynchia tuberculata* sp. nov; male, wings removed.

Male (*fig. 14*).—Length on slide, 5.5 millimeters; length of wing, 5. A very dark species.

Head rather small and rather short and broad, the clypeus (fig. 15, *b*) deeply emarginate anteriorly, but the lateral arms only slightly exceeding the antennæ; vertical triangle (fig. 15, *c*) not emarginate or incised anteriorly; ventral side of the head with numerous setæ.

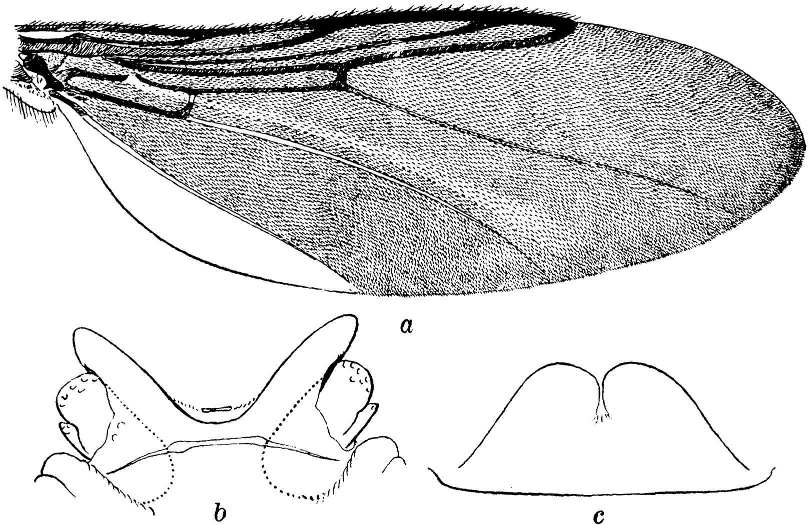

FIG. 13. *Lynchia tuberculata* sp. nov.; *a*, wing; *b*, clypeal region of head; *c*, vertical triangle.

Thorax noticeably broad and laterally angulate; humeral angles (humeral callosities) short and very broad. Legs with a notable paucity of large setæ and a notable abundance of extremely small setæ, the surfaces being almost entirely covered with the latter. Wings (fig. 15, *a*) with the venational type common to the genus but the subcosta not attaining the costa; entirely covered with setulæ, excepting only a portion of the area behind the anal vein, this vein itself, and vein $M_3 + Cu$.

Abdomen devoid of all but the usual basal and apical tergites; bearing numerous small setæ which are not borne on tubercles, or at the most with such tubercles extremely inconspicuous.

Female.—In all respects essentially identical with the male, the only dimorphism being in the position of the genital opening which is closer to the apex of the body, in the absence of the very minute claspers of the male, and the presence of a very small tergal plate just caudad of the basal tergite.

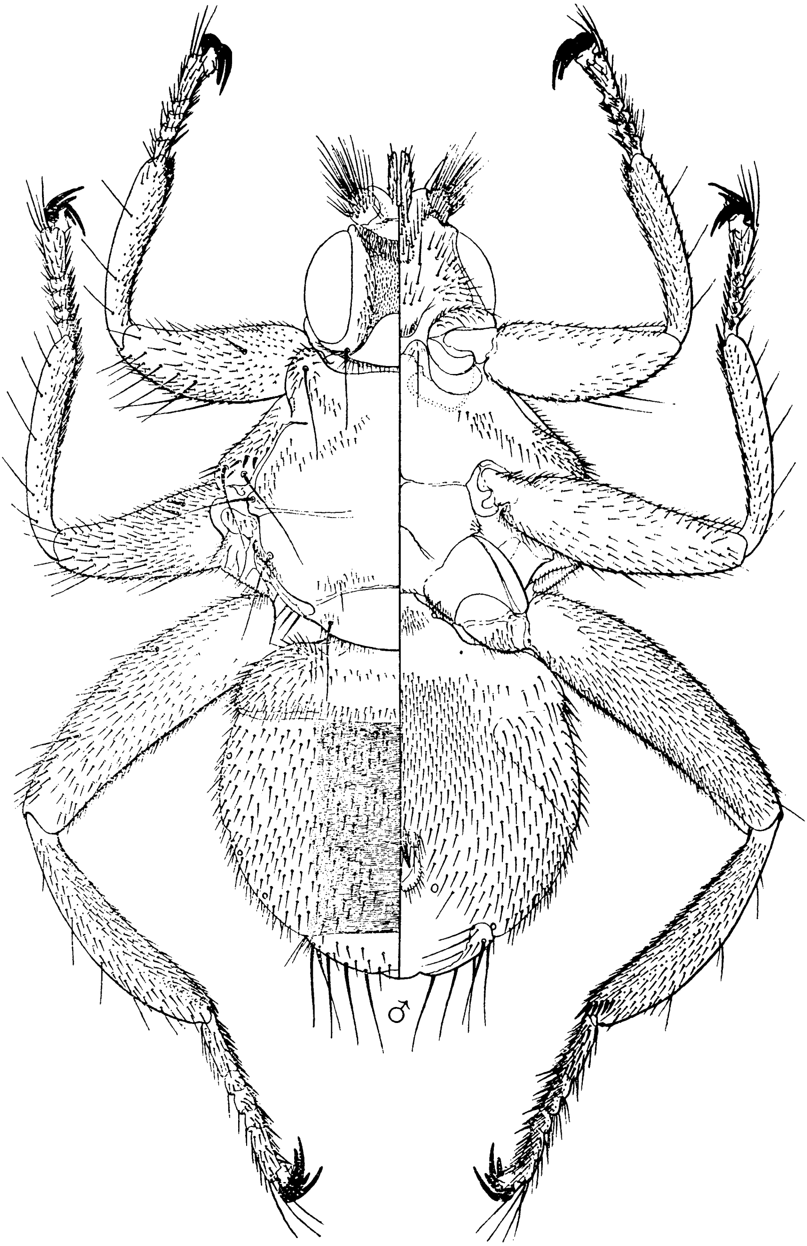

FIG. 14. *Lynchia setosa* sp. nov.; male, wings removed.

Notes.—I somewhat suspect this species of being *L. nigrita* (Speiser), although the only clues to the identity of the latter, which was described from Manila without any indication of host, are to be found in the note as to its dark color and the statement that the humeral callosities are "sehr auffallend stumpf, wenig spitzer als ein rechter Winkel * * *."

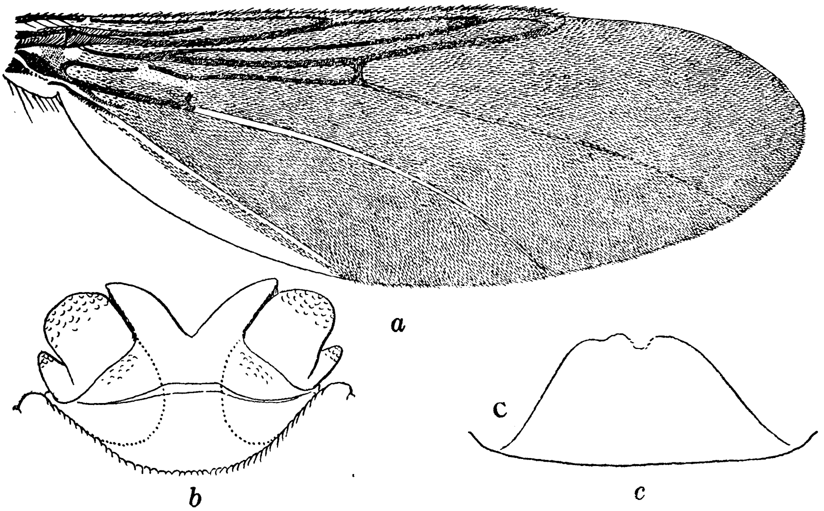

FIG. 15. *Lynchia setosa* sp. nov.; *a*, wing; *b*, clypeal region; *c*, vertical triangle.

LYNCHIA POLLICIPES sp. nov. Figs. 16 and 17.

Specimens examined.—Holotype, a male, one paratype male, and the allotype female from *Astur* sp., September 8, 1925, and a paratype female from *Prioniturus cyaneiceps* Sharpe, August 2, 1925, all from Puerto Princesa, Palawan, Philippine Islands (*McGregor*).

Male (*fig. 16*).—Length on slide, 5 millimeters; length of wing, 5.

Head with the clypeus (fig. 17, *b*) deeply emarginate and prolonged on each side into two very conspicuous, hornlike processes which greatly exceed the antennæ. Vertical triangle with a deep median incision in the anterior border.

Thorax with the humeral angles (humeral callosities) rather prominent and slender. Legs with no specially distinctive characters except that the fourth segment of the anterior tarsi (fig. 17, *c*) has the lobe on one side produced into a conspicuous thumblike process. Wings (fig. 17, *a*) with the venational type of the genus, but with the setulæ arranged in a characteristic fashion, the basal area and the anal area nearly to vein M_3+Cu

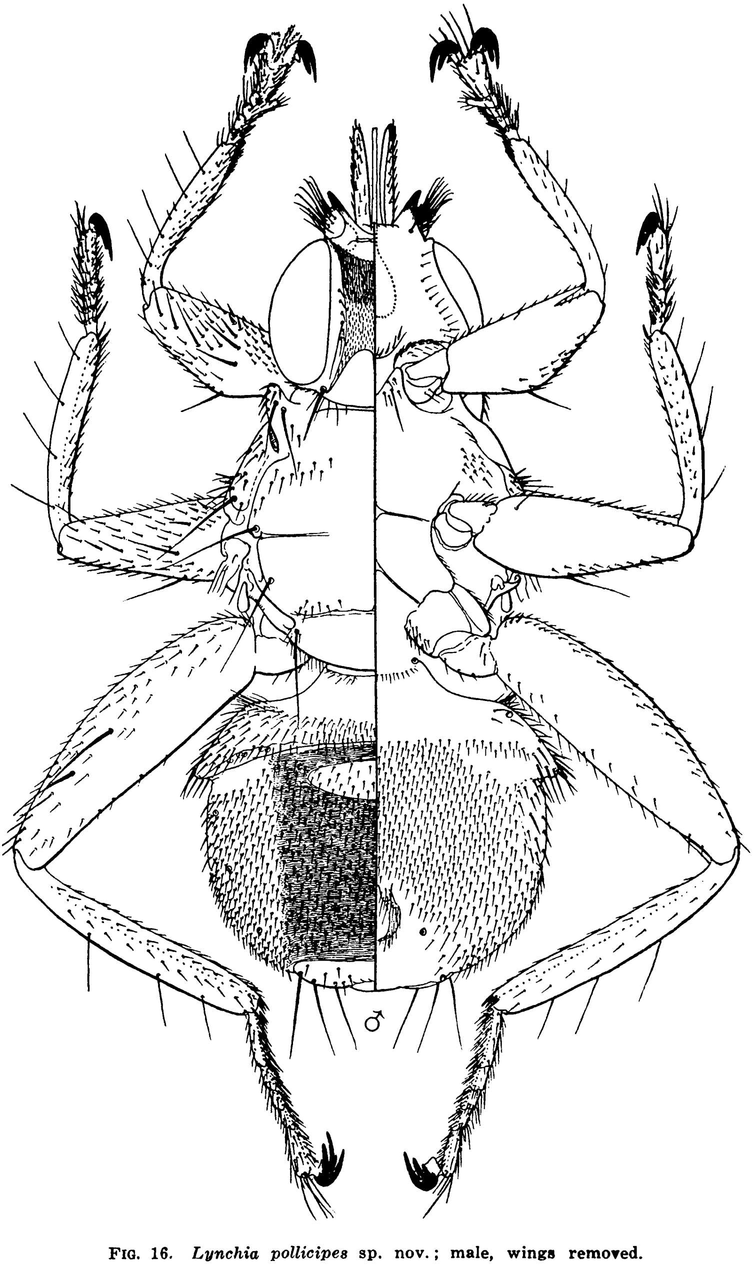

FIG. 16. *Lynchia pollicipes* sp. nov.; male, wings removed.

and a small area just distad of the crossvein formed by M_3 being bare.

Abdomen with the usual basal and apical tergites and with a moderately large tergal plate just caudad of the basal tergite; the membranous areas beset with numerous small, slender setæ, which are not borne upon tubercles, or with such tubercles at the most extremely small.

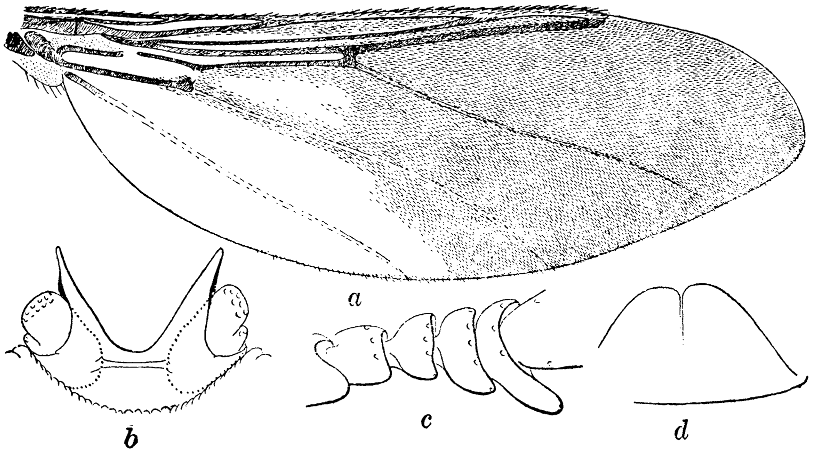

FIG. 17. *Lynchia pollicipes* sp. nov.; *a*, wing; *b*, clypeal region; *c*, portion of anterior tarsus; *d*, vertical triangle.

Female.—In general very similar to the male, differing, in addition to the essential sexual characters, in having the numerous setæ of the median ventral area of the abdomen larger, pale, and rather spikelike.

Notes.—The curious, thumblike lobe on the fourth joint of the anterior tarsi is alone a very distinctive character of this species.

LYNCHIA BICORNA sp. nov. Figs. 18 and 19.

Specimens examined.—A single male from *Penelopides manillæ* (Boddaert), Limay, Bataan Province, Luzon, November 21, 1924 (*McGregor*).

Male (*fig. 18*).—Length on slide, approximately 5.5 millimeters; length of wing, 5.5.

Head with the clypeus (fig. 19, *b*) deeply emarginate, the lateral arms prolonged into hornlike processes that far exceed the antennæ. Vertical triangle (fig. 19, *c*) with a deep median incision anteriorly.

Thorax with the humeral angles (humeral callosities) very prominent and slender. Sternum prolonged into a hooklike proc-

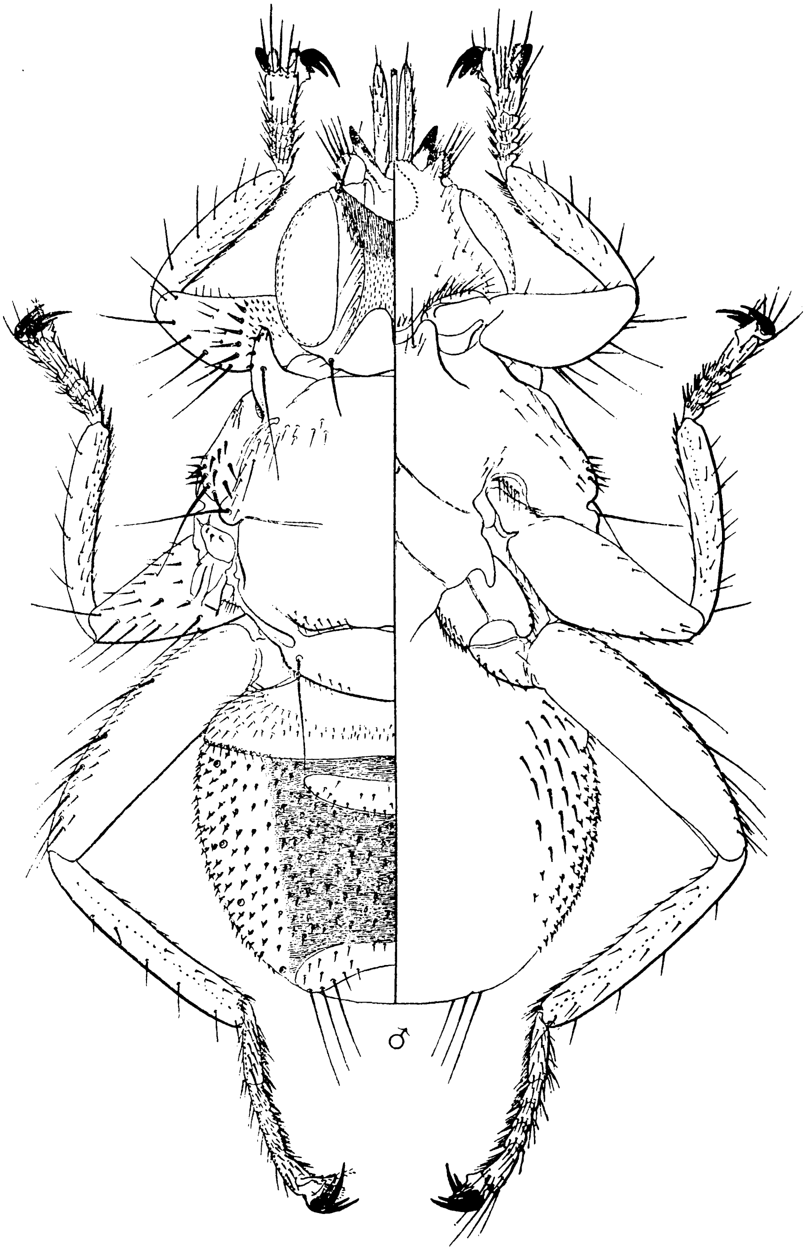

FIG. 18. *Lynchia bicorna* sp. nov.; male, wings removed. Abdomen incomplete because of mutilation of specimen.

ess that overlies the base of the posterior coxæ. Legs with no especially distinctive characters. Wings (fig. 19, *a*) with the venational pattern of the genus, but with nearly the posterior half devoid of setulæ.

Abdomen with the usual basal and apical plates and with a rather large tergal plate just caudad of the basal plate. Derm of the dorsum beset with rather numerous small setæ which are borne upon small tubercles.

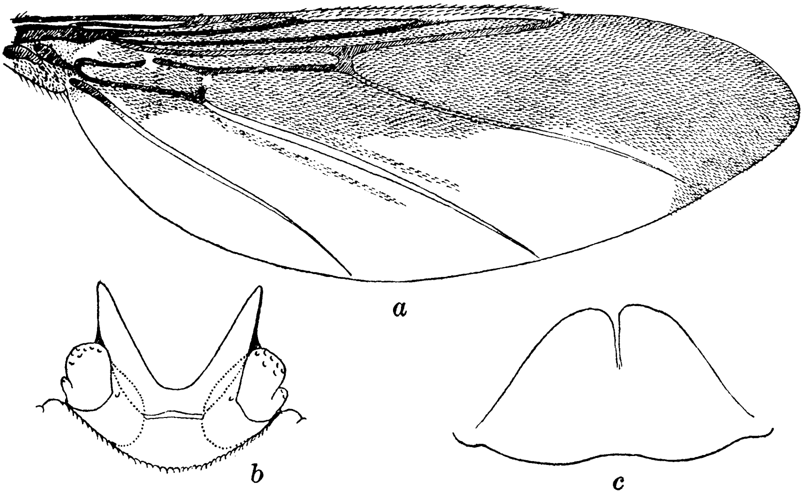

FIG. 19. *Lynchia bicorna* sp. nov.; *a*, wing; *b*, clypeal region; *c*, vertical triangle.

Notes.—The single specimen is mutilated to such an extent that it is not possible to reconstruct the ventral side of the abdomen, but it is evidently a distinct and entirely recognizable species, so I am nevertheless describing it.

There is a faint possibility that this may be *L. dioxyrhina* (Speiser), a species described from New Guinea from *Rhytidoceros plicatus* Forst. The basis for this possibility is to be found in Speiser's remarks, "Scheitel in der Mitte buchtig nach hinten vorgezogen, daneben eingezogen," a condition which is evident in the specimen at hand; and also the statement that upon the anterior femur "ist eine Reihe von mittellangen starren Borsten characteristisch, welche quer über die vordere Fläche des Schenkels verlaufend eine unbeborstete Würzelhälfte von einer unregelmässig beborsteten Endhälfte scheidet."

The latter condition is well fulfilled by this specimen, although the character is present in other species as well. Also, there is agreement in size. However, there may very well be several species to which all of these conditions will apply equally well.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. *Ornithoica pusilla* (Schiner); *a*, abdomen of male; *b*, posterior margin of posterior trochanter.
2. *Ornithoica unicolor* Speiser; wing.
3. *Ornithoica philippinensis* sp. nov.; *a*, abdomen of male; *b*, posterior margin of posterior trochanter.
4. *Ornithomyia avicularia* (Linnæus) ? ; female, wings removed. From a specimen from *Anthus gustavi* Swinhoe, Philippine Islands.
5. *Ornithomyia avicularia* (Linnæus) ? ; *a*, wing; *b*, claws; *c*, clypeal region of head; *d*, first segment of posterior tarsus. From the same specimen as fig. 4.
6. *Ornitheza metallica* (Schiner); abdomen of male.
7. *Ornithoctona nigricans* (Leach); female, wings removed. From a Philippine specimen.
8. *Ornithoctona nigricans* (Leach); *a*, wing; *b*, apex of anterior tibia of female; *c*, apex of anterior tibia of male; *d*, clypeal region; *e*, abdomen of male; *f*, first segment of posterior tarsus.
9. *Myiophthiria reduvioides* Rondani; abdomen of male. From a specimen from the New Hebrides.
10. *Olfersia spinifera* (Leach); male, wings removed. From a Philippine specimen from *Fregata aquila* (Linnæus).
11. *Olfersia spinifera* (Leach); *a*, wing; *b*, claws; *c*, portion of derm of abdomen; *d*, clypeal region; *e*, posterior margin of head. From the same specimen as fig. 10.
12. *Lynchia tuberculata* sp. nov.; male, wings removed.
13. *Lynchia tuberculata* sp. nov.; *a*, wing; *b*, clypeal region of head; *c*, vertical triangle.
14. *Lynchia setosa* sp. nov.; male, wings removed.
15. *Lynchia setosa* sp. nov.; *a*, wing; *b*, clypeal region; c, vertical triangle.
16. *Lynchia pollicipes* sp. nov.; male, wings removed.
17. *Lynchia pollicipes* sp. nov.; *a*, wing; *b*, clypeal region; *c*, portion of anterior tarsus; *d*, vertical triangle.
18. *Lynchia bicorna* sp. nov.; male, wings removed. Abdomen incomplete because of mutilation of specimen.
19. *Lynchia bicorna* sp. nov.; *a*, wing; *b*, clypeal region; *c*, vertical triangle.

HYNNIS MOMSA, A NEW PHILIPPINE PAMPANO

By Albert W. Herre

Chief, Division of Fisheries, Bureau of Science, Manila

ONE PLATE

HYNNIS MOMSA Herre, sp. nov.

Dorsal I–20; anal I–16; about 10 scutes in lateral line, the last 5 much enlarged, very broad and high, but the last one much smaller than the 4 preceding.

The naked, angulate, elongate-rhomboid, roughly pentagonal body very deep and strongly compressed laterally, its greatest depth at origin of dorsal, 2.37 times in length; head higher than long, very narrow from side to side; its depth through center of eye 3.65, its length 3.92 times in total length; eye 4.77 times in head, 2.28 times in snout, which is 2.09 times in head; interorbital very high and narrow, its height 1.81 times eye, its thickness about 1.25 times eye; profile descends rapidly from origin of dorsal to the sharp angle just beyond eye, then at an angle of about 45° to mouth; ventral profile sharply angulate at origin of anal; mouth slightly oblique, maxillary 3.1 times in head, chin full, heavy, lower jaw slightly longer than upper; suborbital very deep, nearly equal to snout; dorsal low, first ray highest, a tenth higher than first anal ray, which is 1.86 times in head, dorsal and anal otherwise nearly identical; arch of lateral line high and very long, its diameter greater than length of straight part to fifth enlarged scute from end; depth of the elongate caudal peduncle less than its breadth, about 3.66 times in its length, 7.9 times in head; the very long, narrow, falcate pectoral reaches beyond a vertical from base of tenth dorsal ray, 2.86 + times in length; origin of the short ventral much in advance of pectoral and beneath opercle, its length 0.95 the height of first anal ray, and a little less than twice in that of head; caudal deeply and widely forked, about 3.84 times in length.

Color silvery, chin pearl white, with a black bar on upper posterior margin of opercle and a black spot in axil of pectoral; a short distance below dorsal a dark steel blue bar about 25 millimeters wide extends back to top of caudal peduncle and along it to caudal fin; on upper half of body, above pectoral and posteriorly, are dusky spots like thumb marks; the fins have no markings. Seen from above the fish is very dark steel blue, with a metallic luster.

Here described from the type, No. 15216 Bureau of Science collection. It is a ripe female, 730 millimeters long, or 920 millimeters including caudal fin, and was obtained in the Manila market April 12, 1927. A few specimens of this large fish are occasionally seen in the Manila market during the spring months. They come from near the entrance to Manila Bay or from Subic Bay, and are evidently an offshore fish, only caught at infrequent intervals in fish corrals.

Momsa, a Visayan name for carangoid fishes.

ILLUSTRATION

PLATE 1. *Hynnis momsa* sp. nov. Ripe female. (Drawing by Pablo Bravo.)

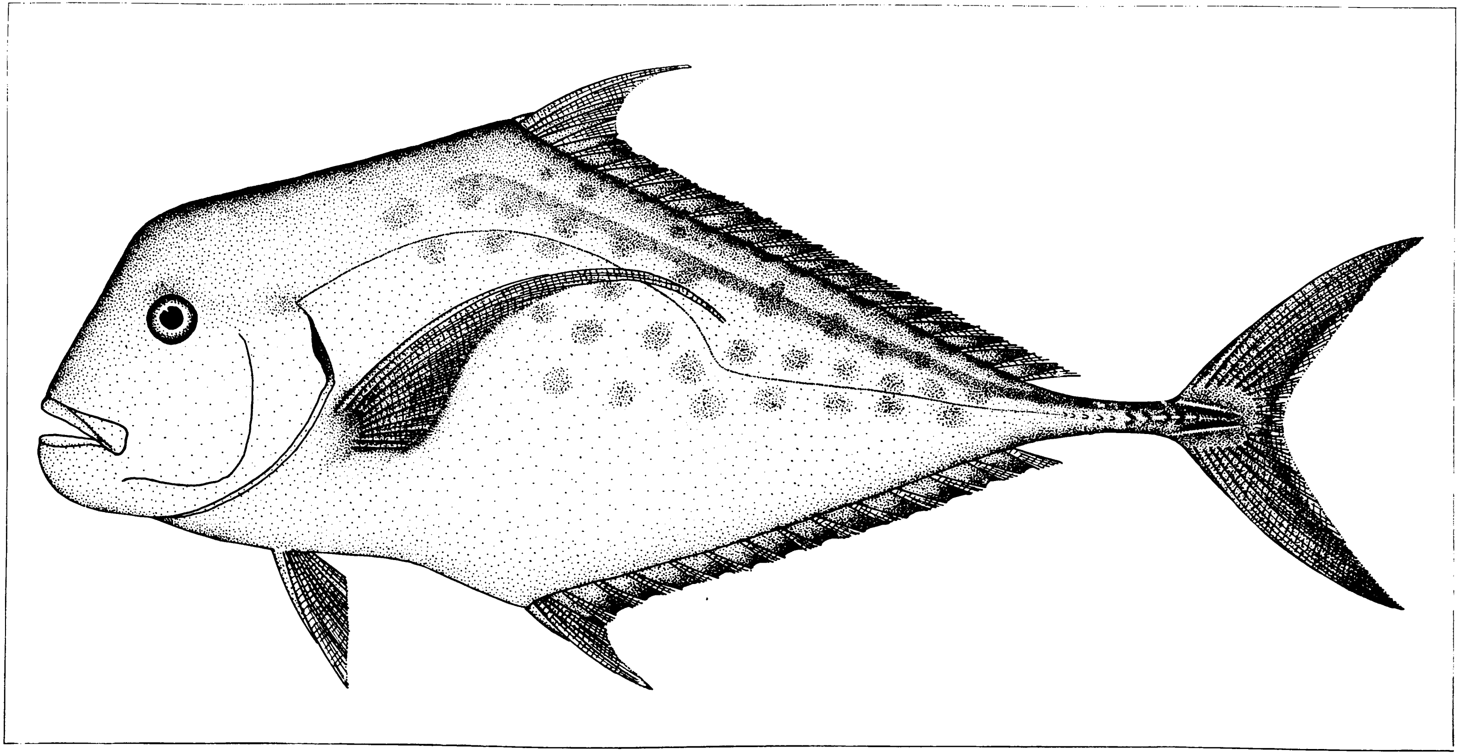

PLATE 1. HYNNIS MOMSA SP. NOV.

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THE PHILIPPINE JOURNAL OF SCIENCE

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DAVALLODES AND RELATED GENERA

By EDWIN BINGHAM COPELAND

Of Chico, California

FIVE PLATES

A tribe or family of ferns having *Davallia* as its typical genus has been recognized by practically all students of ferns for a full century. A tribe of "Davallieae" was first so called by Gaudichaud in 1826, albeit as a group subordinate to Hymenophyllaceæ. As a name is needed for the group of genera to be treated here, and this one is established in literature, I retain it, but in a much more restricted sense than has been usual.

The ferns here in question—to locate them most conveniently—are, in Christensen's Index: *Humata; Davallia,* but excluding *Prosaptia;* and section *Davallodes,* of *Microlepia.*

It is an Old World group, ranging from the Canaries eastward across Polynesia, but without a known representative in America. It is a group of epiphytes, with the stipe functionally or vestigially jointed. So far as I know any of them to be terrestrial, I regard them, as I do *Polypodium vulgare,* as having descended to the ground.

The affinities of the Davallieæ, sensu strictiore, will be discussed in connection with *Davallodes.* In advance, it may be said that they have affinity with *Oleandra,* but none equally close with any of the various other genera which have hitherto been incorporated into their tribe. Of the genera thus associated by Diels and Christensen, *Arthropteris* is more probably related to *Nephrolepis. Nephrolepis* is kin of *Cystodium,* going back to the Dicksonieæ independently of *Dennstaedtia. Saccoloma* is likewise at the nearest a cousin of the Dennstaedtieæ.

Dennstaedtia, Microlepia, and *Leptolepia* are nearly related among themselves, and close to the ancestry of *Tapeinidium,* of *Schizoloma* and its relatives (*Syngramma, Taenitis,* et al.), and probably of *Lindsaya, Odontosoria,* and *Diellia. Monachosorum* is more probably cyatheoid in origin, and *Dictyoxyphium,* whatever its affinity, seems far from any of these.

The genera to be recognized here, with definitions restricted to their essential characters, follow.

GENERA OF DAVALLIEÆ

Araiostegia.—Fronds thin, glabrous, several times pinnate with narrow ultimate segments; rhizome scales broad, not black, nor conspicuously ciliate, nor aciculate; sori small or of moderate size; indusium thin, free except at the base.

Davallodes.—Fronds thin, pubescent, several times pinnate with narrow ultimate segments, not deltoid. Rhizome scales aciculate above the peltate base, mostly black, not (or hardly) ciliate; sori small; indusium thin, variously affixed.

Trogostolon.—Fronds firm but hardly coriaceous, glabrous, several times pinnate with narrow ultimate segments, deltoid; rhizome scales aciculate above the peltate base, black ciliate; sorus of moderate size; indusium firm but not coriaceous, the upper part free.

Leucostegia.—Fronds herbaceous, pale green, glabrous, several times pinnate but ultimate segments not narrow; paleæ of rhizome broad, not black nor ciliate; sori very large; indusium fixed by base or base and sides, thin. Terrestrial ferns.

Humata.—Frond coriaceous, usually deltoid, glabrous or somewhat scaly; rhizome scales not aciculate, nor black, not ciliate or but slightly so; sori of moderate size; indusium firm to coriaceous, the sides free.

Davallia.—Frond coriaceous, glabrous, several times pinnate; rhizome scales ciliate, not black and hardly aciculate; indusium fixed by base and sides.

Scyphularia.—Frond coriaceous, glabrous, simply pinnate with broad pinnæ; rhizome scales black, aciculate, not conspicuously ciliate; indusium fixed by base and sides.

Genus **ARAIOSTEGIA** Copeland, novum

PLATES 1 AND 2

Filix Davalliae affinis, rhizomate repente paleis haud aciculatis ferrugineis, castaneis vel similiter coloratis non nigris, latis, non ciliatis vestito, articulatione stipitis dubia; fronde lan-

ceolata, ovata vel enim triangulare sed pinnis infimis sequentibus similibus, glabra, haud coriacea, aut tripinnatifida aut enim quinquepinnatifida, segmentis ultimis angustis; soris parvis, indusio tenue, basi affixo, sursum libero. Nomen ad indusium tenue refert.

ARAIOSTEGIA HYMENOPHYLLOIDES Copel., comb. nov., type species.

Aspidium hymenophylloides BLUME, Enum. (1828) 172.

Other species referable to this genus are:

ARAIOSTEGIA ATHAMANTICA (Christ) Copel.

Davallia athamantica CHRIST, Bot. Soc. Fr. Mém. 1 (1895) 65. Yunnan.

ARAIOSTEGIA CLARKEI (Baker) Copel.

Davallia Clarkei BAKER, Syn. Fil. (1874) 91. Himalaya, Yunnan.

ARAIOSTEGIA MULTIDENTATA (Wall.) Copel.

Aspidium multidentatum WALL., nomen nudum.
Davallia multidentata HOOKER, Syn. Fil. (1867) 91. Himalaya.

ARAIOSTEGIA PARVIPINNULA (Hayata) Copel.

Davallia parvipinnula HAYATA, Mater. Fl. Form. (1911) 431.
Leucostegia parvipinnula HAYATA, Icones Form. 4 (1914) 205, fig. 139. (See discussion, ibid.) Formosa.

ARAIOSTEGIA PSEUDO-CYSTOPTERIS (Kze.) Copel.

Davallia Pseudo-cystopteris KZE., Bot. Zeit. (1850) 68. Himalaya.

ARAIOSTEGIA PULCHERRIMA (Baker) Copel.

Davallia pulcherrima BAKER, Kew Bull. (1895) 53. Yunnan.

ARAIOSTEGIA PULCHRA (Don) Copel.

Davallia pulchra DON, Prod. Fl. Nepal. (1825) 11. Himalaya to Ceylon and China.

ARAIOSTEGIA YUNNANENSIS (Christ) Copel.

Davallia yunnanensis CHRIST, Bull. Boiss. 6 (1898) 970. Yunnan.

Other possible members of this genus are:

Acrophorus assamicus Bedd.
Davallia Beddomei Hope.
Davallia perdurans Christ.
Davallia rigidula Baker=*Yunnanensis.*
Leucostegia yaklaensis Bedd.

There have also been referred to *Leucostegia,* as a subgenus, several ferns from New Guinea and still farther east, with descriptions which would better fit *Araiostegia.* It is a priori quite improbable that a genus at home in Yunnan and the Himalayas, and unknown in Malaya and the Philippines except for a single species, recurs in diversity farther away. In the absence of the rhizome, a *Leptolepia* might easily be placed here;

Balantium dubium has been so misplaced; and the descriptions of two New Caledonia species permit even *Dryopteris* to be suspected.

If *A. hymenophylloides* be left out of account for the moment, the remaining genus is restricted to a very narrow range, only *A. pulchra* ranging south to Ceylon, and *A. parvipinnula* to Formosa.

Genus DAVALLODES Copeland

The original formal diagnosis of this group as a genus[1] is merely: "Genus Davalliearum, stipitibus articulatis, rhizomate pilis vestito." As this is neither accurate nor adequate, it is here replaced with one more sufficient to define the group as now understood:

Rhizomate repente vel scandente, valido, systemate vasculare reticulato, paleis basibus peltatis deinde aciculate protractis vestito; frondibus seriatis, haud deltoideis, tenuibus, axibus et saepe lamina pallide pubescentibus, pinnatis, pinnis ad alam rhachillae pinnatifidis, pseudopinnulis aut pinnate incisis seu eodem more magis dissectis; soris ad laminam dorsalibus, ad venam terminalibus saepius ad ramum venae abortivum ita ut laterales videntur, indusiatis, indusiis quoad formam variis, semper tenuibus.

The brief original diagnosis provided distinctions from *Davallia* and *Microlepia,* but did not properly exclude *Scyphularia,* nor several species which a somewhat more careful discrimination has placed in *Leucostegia,* and for which the genera *Araiostegia* and *Trogostolon* are here provided. As here defined, *Davallodes* is a quite natural genus. As genera go, it is remarkably uniform in gross characters—frond form, dissection, texture, paleæ—which commonly serve for the identification of species, and no less remarkably varied in the character, more often valid for the recognition of groups of genera, of the indusium.

This indusium may be ovate, and fixed by the middle of the base; it may be reniform, and fixed by more or less of its base; it may be much wider than long, and fixed by the whole base, and such an indusium may be shortened until it is sharply evident; or the sides may be attached, making it cup- or funnel-shaped; or it may be very long and narrowly cylindrical. Accustomed as we are to the identification of genera by the form and attachment of the indusium, an obviously natural group with various indusia makes a strong appeal for recognition as the parent group of the clearly related genera with indusia of definite type.

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[1] Philip. Journ. Sci. § C 3 (1908) 33.

If this suggestion be tested, it will be found possible to trace connections with some of the other genera, with considerable plausibility. Taking the characteristics of *Davallodes* one at a time, the transition to *Davallia,* for example, may be made to appear a gradual one. In sorus and form of indusium, several species of *Davallodes* are like *Davalliae*—*Davallodes dolichosorum* like *Davallia solida,* for example. In form of frond, *Davallia wagneriana,* with basal pinnæ similar to the others, is not very different from *Davallodes borneense.* They have in common the winged rachillæ of the pinnæ, and this *Davallia* is not without the tinge of red, which is conspicuous in this *Davallodes,* and *D. borneense* is notable in its own genus for nakedness and firmness of texture; but their indusia and the paleæ of their rhizomes are utterly unlike.

Of the species here treated as *Davallodes,* the other most divergent one is *D. membranulosa.* It is the smallest of the genus, and therewith its rachis is winged almost throughout. In texture, pubescence, general features of dissection, and a measure of inconstancy of indusium, it is absolutely a *Davallodes.* Its paleæ, however, are less abruptly narrowed, the needlelike point is short and less rigid, and in the mass they are ferruginous instead of black or red-black. The transition from *Davallodes* to *Araiostegia* exemplified by this species is very probably evidence of intimate affinity. With more plausibility than confidence, such connections can be traced between *Davallodes* and *Araiostegia* and the several other genera.

However, in the present state of our knowledge, the soundest opinion seems to me to be that no one of the genera of the Davallieæ is to be regarded as the parent of the others; but that, rather, they have a common descent from a more generalized ancestor which, if it exists, has not been recognized as such. To use the familiar figure of the phylogenetic tree, they are coördinate branches, not a series. In some respects, *Araiostegia* looks like the least specialized of them; but, so far as I am transferring species to it, it has the compact geographical range of a recent group, not nearly old enough to be or to exemplify the parent of *Davallia,* or *Davallodes,* or even of *Leucostegia.*

Davallodes has indusia more diverse in form than those of any other genus of ferns; but it is in this sole respect that it appeals for recognition as primitive. Its remarkable uniformity in other respects is evidence of high specialization, not yet interpreted in detail. The aciculate paleæ look like highly specialized structures, such as, once evolved, would not be likely to be lost. Taking this view, and granting that the connection between *Davallodes* and *Araiostegia* is a close one, the direction of descent would seem to be from *Araiostegia* to *Davallodes,* rather than the reverse.

However, one does not safely draw a conclusion from one side of the evidence. Also, it is very difficult to fix on a genus as primitive in its group, while a more remote source of the group as a whole is uncertain. I have in the past assumed, as have many or all others interested in this field in recent years, that *Davallia* and *Microlepia* were intimately related. *Microlepia* is positively primitive, as compared with *Davallia.* It is so positively more primitive that, if there were any near affinity between it and the Davallieæ as here limited, the most primitive of the latter should be identifiable by their resemblance to it. In the good old days of the supremacy of the indusium, this would have been easy. *Davallodes hirsutum* has the indusium of *Microlepia,* in form, attachment, texture, and pubescence; but it has a dictyostele, and is an epiphyte (these two features perhaps correlated), and it has peltate scales instead of hairs with unicellular base. To my great surprise, I have been unable to find any probable connection between *Microlepia* and any one of the genera here under consideration.

Outside of the Davallieæ, such scales are found in a very few other ferns. *Christiopteris Sagitta* has them. So have *Polypodium* (*Phymatodes*) *glauco-pruinatum* and *P.* (*P.*) *albido-squamatum;* and those of *Goniophlebium* are not very different. All of these are placed, with a large measure of probability, in the general alliance of matoniid ferns, among which indusia of any kind are unknown.

Such paleæ are borne also by *Oleandra*—more specifically by certain (or uncertain) *Oleandra* species of the Malay region. Other species of *Oleandra* have paleæ quite exactly like those of certain species of *Davallia,* in form, color, and texture, and in the peculiarly ciliate margins. In stelar structure, and in the articulation of the stipe, *Oleandra* and the Davallieæ are alike. In form and attachment of the indusium, most species of *Oleandra* are like *Humata, Leucostegia immersa,* and some species of *Davallodes.* In leaf texture, *Oleandra* has not much more generic character than *Davallodes* has in form of indusium, wherein it is a worthy relative of a group including *Davallia* and *Davallodes.* The fronds of some of its species are pubescent, with hairs quite like those of *D. hirsutum;* others are glabrous, with the color and luster of *Scyphularia.* Altogether, I consider the affinity of *Oleandra* and the Davallieæ sure beyond a reasonable doubt, and believe that it is in *Oleandra*—not, either directly or indirectly, in *Microlepia* and *Dennstaedtia*—that the ancestral line of the Davallieæ is traceable. *Oleandra* is itself a very remarkable genus, to which I hope to return for a thorough study at another time.

As a matter of convenience, since the species have not been assembled before, I quote the original diagnoses of the species of *Davallodes.* A key for their determination follows:

Key to the species of Davallodes.

1. Frond and indusia not red, frond more or less hairy.
    2. Indusium fixed by base, free margin rounded, as in *Humata.*
        3. Paleæ on rhizome ferruginous.............................. 1. D. **membranulosa.**
        3. Paleæ dark, aciculate.
            4. Pinnæ with short, winged stalks.......................... 2. D. **gymnocarpum.**
            4. Pinnæ adnate-sessile.. 3. D. **laxum.**
    2. Indusium fixed by base and sides, as in *Davallia.*
        3. Indusium not elongate.
            4. Pinnules merely incised.
                5. Pinnules not congested nor deeply cut................ 4. D. **hirsutum.**
                5. Pinnules contiguous, their apices deeply toothed. 5. D. **congestum.**
            4. Deeply tripinnatifid.. 6. D. **urceolatum.**
        3. Indusium much longer than broad.
            4. Frond gradually narrowed below.......................... 7. D. **dolichosorum.**
            4. Not gradually contracted below...................... 8. D. **grammatosorum.**
    2. Indusium fixed by a part of the base and pointed, as in *Cystopteris.*
        3. Stipes naked.. 9. D. **nephrodioides.**
        3. Stipes pubescent.. 10. D. **viscidulum.**
1. Frond and indusia reddish, glabrous except for main axes. 11. D. **borneense.**

DAVALLODES MEMBRANULOSUM (Wall.) Copel., comb. nov.

Davallia membranulosa WALL., Hooker, Spec. Fil. 1 (1846) 159.

Caudex hispid with very long slender subulate rigid membranaceous scales, frond small very thin and membranaceous ovato-lanceolate and as well as the slender stipes and rachis pubescenti-hirsute bipinnate, pinnae alternate lanceolate their rachis winged, pinnules lanceolate pinnatifid, the segments ovato-lanceolate subfalcate very acute entire or rarely toothed, involucres small ovato-subrotund acute very thin and membranaceous fixed by the broad base the rest free. (Tab. LIII. A.) *Wall. Cat. n.* 255.

Hab. Nepal, *Wallich.*—A small and very delicate species, with the habit of *Cystopteris*, but the sorus is at the apex of a vein, although the involucres are more sharp-pointed than is usual with *Davallia.* Caudex with long ferruginous narrow subulate scales. Stipes 2–3 inches high, and, as well as the rachis, which is winged above, very slender, almost filiform. Frond a span long. Primary pinnae 2 inches long, lanceolate, of a red-brown color. (*Hooker, loc. cit.*)

The plate represents an unmistakable *Davallodes,* the less aciculate scales of the rhizome not being evidently different as depicted. The indusium is most like that of *D. viscidulum,* but less pointed and more broadly attached, not at all cordate.

DAVALLODES GYMNOCARPUM Copel.

Davallodes gymnocarpum COPELAND, Philip. Journ. Sci. § C 3 (1908) 34.

Stipite 3–9 cm alto; fronde 30–40 cm alta, 12–16 cm lata, pinnis majoribus acuminatis, inferioribus sensim valde diminutis, infimis late ovatis 2–3 cm longis; segmentis $^{\mathrm{I}}$ oblongis, rotundato-obtusis, infimis (apud rhachides) maximis, ultra mediam laminam incisis; segmentis $^{\mathrm{II}}$ falcatis, acutis, ciliatis, infimis aliis aequalibus, integris; soris minutis, ad baseos lobarum; indusiis variabilibus, semper quam altis latioribus, non ciliatis. Tab. V.

Monte Canlaon, Insulae Negros, 600 m. s. m. *Copeland* 2075.

Easily distinguished from *D. hirsutum* by the form of the frond and that of the indusium. (*Copeland, loc. cit.*)

DAVALLODES LAXUM Copel., sp. nov. Plate 3, fig. 1.

Rhizomate (sicco) nigro, pilis nigris 6 mm longis basibus peltatis fusco-cinctis vestito; stipite 20–25 cm alto rhachique breviter castaneo- vel fusco-pilosis; fronde 30–50 cm alta, 14–18 cm lata, acuminata, tenuiter herbacea, praecipue ad costas strigosa; pinnis angustissime adnatis, maximis vix 10 cm longis, 2.0–2.5 cm latis, acuminatis, ad alam conspicuam rhachillae pinnatifidis; pseudo-pinnulis lanceolato-oblongis, haud contiguis, apice rotundatis, inferioribus regulariter medio ad costas incisis, lobis falcatis acutis, plerumque approximatis; indusiis latis, more Humatae basibus adnatis, margine libera rotundata minute et pulcherrime albido-ciliatis ciliis capitulatis, alibi glabris.

Luzon; Benguet. Merrill, "Philippine Plants," No. 957. Type in herb. E. B. C.: Bagnen, altitude 1,500 m. s. m. Copeland s. n. Nov. 1905.

Most like *D. hirsutum* in appearance, but recognizable by the comparatively remote "pinnules." The indusia are more like those of *D. gymnocarpum,* but much more evident and persistent, besides being finely ciliate.

DAVALLODES HIRSUTUM (J. Sm.: Presl) Copel.

Davallodes hirsutum (J. Sm., Presl) COPELAND, Philip. Journ. Sci. § C 3 (1908) 33.

Leucostegia hirsuta J. SM., Journ. Bot. 3 (1841) 416, nomen nudum.

Davallia ciliata HOOKER, Spec. Fil. 1 (1846) 184, pl. 60, A (non Presl, 1822).

Microlepia hirsuta PRESL, Epim. Bot. (1849) 97 (no description, but a citation of Hooker's).

Hooker's diagnosis reads as follows:

> Caudex creeping crinite, frond ovato-lanceolate very flaccid membranaceous hairy especially on the veins (hairs soft silky), pinnate, pinnae from a broad base oblong acuminate bipinnatifid, primary segments oblong obtuse separated from each other almost to the rachis, ultimate ones ovate subfalcate very acute ciliated entire or with one or two minute teeth, sori small at a distance from the margin almost in the centre of a segment, involucres small half-cup-shaped ciliated, stipes and main rachis (which is rigid) pubescent with short brown hairs . . .
>
> Hab. Luzon, *Cuming* n. 174.

Common in southern Luzon. Range in doubt because of reference of other species to this one.

DAVALLODES CONGESTUM Copel., sp. nov. Plate 3, fig. 2.

Rhizomate late scandente, pilis nigrescentibus 6 mm longis basibus peltatis pallido-cinctis vestito; stipite 10 cm alto rhachique castaneo-pubescentibus; fronde 35 cm alta, 10–12 cm lata, pinnis infimis paullo abbreviatis; pinnis horizontalibus, anguste adnatis, obtusis vel acutis haud acuminatis, basibus paullo dilatatis, ad alam 0.5–1.0 mm latam rhachillae pinnatis; pseudopinnulis oblongis, imbricatis, apicibus rotundatis argute inciso-dentatis dentibus acutis non falcatis; pilis ad venas aliquantum sparsis, articulatis; indusio glabro, rarius ciliis perpaucis ornato, semicupuliforme.

Mindanao, Todaya, on slopes of Mount Apo, altitude 1,200 m. s. m. Copeland No. 1481. October, 1904.

This is very near to *D. hirsutum*, but quite different in aspect because of the obtuse pinnæ and the crowded "pinnules" with deeply cut apices. The indusia of the two species are similar in form, but those of *D. congestum* are more uniformly cup-shaped and rather larger. The long hairs pictured by Hooker[2] as characteristic of *Davallia ciliata* are not present on all the plants I still construe as *D. hirsutum.*

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[2] Spec. Fil. 1, pl. 60 A.

DAVALLODES URCEOLATUM Copel., sp. nov.

Rhizomate densissime pilis sordide rubido-fuscis nigrescentibus basibus peltatis vestito; stipite usque ad 15 cm alto, rhachique pube minuta fusco-fulva vestitis; fronde 30 cm alta, ovata, tripinnatifida; pinnis brevi-pedicellatis, medialibus 7 cm longis, acutis vel acuminatis, ad alam angustissimam rhachillae ubique dense puberulae pinnatis; pinnulis infimis acroscopicis maximis 2 cm longis, basiscopicis paullo minoribus, plerisque 6 mm latis, obtusis, profunde pinnatifidis; segmentis obtusis, inciso-lobatis, herbaceis, glanduloso-puberulis; soris ad segmentum quodque pinnulae 1–4; indusiis basi et apice rotundato-truncatis, apice integris vel sublaceris, lateribus adnatis sursum paullulum divergentibus.

Sumatra, Berastagi, altitude 1,500 m. s. m. Scandent on trees in ravines. H. S. Yates No. 526, May, 1923.

In the dissection of the frond more like *D. viscidulum* than any other species, but utterly different in its indusium, and much more pubescent than are my Javan specimens of that species.

DAVALLODES DOLICHOSORUM Copel., sp. nov.

Rhizomate pilis atro-rubidis 8 mm longis rectis squarrosis basibus peltatis vestito; stipite breve, 3–4 cm longo, rhachique pube breve castanea vestitis; fronde 40 cm alta, late lanceolata, utrinque angustata, acuminata, tenuiter herbacea, lamina fere glabra; pinnis medialibus 5 cm longis, 1.5 cm latis, plerisque acutis, anguste adnatis, ad alam rhachillae pubescentis pinnatifidis; segmentis oblongis, apice rotundatis, fere contiguis, inciso-serratis; pinnis inferioribus decrescentibus, infimis plus minus 1 cm longis; indusio nudo, quam lato duplo vel triplo longiore.

German New Guinea. On trees in the forest, Mount Kani, altitude 600 m. s. m. Schlechter No. 17857, June, 1908.

Judging by the sorus, this seems near to *D. grammatosorum*, of Mindanao; but it is very different in frond form, and is notable in the genus for its lack of hairiness.

DAVALLODES GRAMMATOSORUM Copel.

Davallodes grammatosorum COPELAND, Philip. Journ. Sci. § C 3 (1908) 34.

Stipite ca. 15 cm alto; fronde 40–65 cm alta, 20–26 cm lata, deorsum vix angustata; pinnis valde acuminatis; segmentis [1] lanceolato-oblongis, obtusis vel subacutis, ultra mediam laminam incisis, infimis majoribus; segmentis [11] oblongo-lanceolatis, falcatis, non ciliatis, infimis acroscopicis maximis furcato-venosis et interdum plurisoratis; indusio ca. 0.7 mm longo, lineari-oblongo, nudo. Tab. VI.

San Ramon, Insulae Mindanao, 600 m. s. m. *Copeland* 1724; Camp Keithley, *Clemens* 1137.

This is the "*Microlepia hirsuta*" of my "Comparative Ecology of San Ramon Polypodiaceae." (*Copeland, loc. cit.*)

DAVALLODES NEPHRODIOIDES Copel., comb. nov.

Davallia (*Leucostegia*) *nephrodioides* BAKER, Journ. Linn. Soc. **24** (1887) 257.

Rhizomate late repente, paleis nigris piliformibus basi peltatis praedito, stipitibus elongatis nudis, frondibus magnis membranaceis oblongo-lanceolatis bipinnatifidis parce pilosis, pinnis lanceolatis subpetiolatis, pinnulis multijugis pectinato-pinnatifidis basi confluentibus, venis in pinnulis copiose pinnatis, soris medialibus, induso parvo reniformi.

Niah, Sarawak, *Mr. Charles Hose.*

Nearly allied to the Javan *D. Kingii* Baker, lately figured in Hooker's Icones, tab. 1622. Rhizome firm, epigaeous, ⅓ in. in diam.; paleae fine, hair-like, spreading. Stipe stiffly erect, ½ ft. long. Frond 2–3 ft. long, 8–9 in. broad at the middle, green, hairy mainly on the rhachides of the pinnae, quite destitute of scales. Pinnae subpetiolate, the central ones 4–5 in. long, 1–1¼ in. broad, the lower rather smaller, all except the lowest cuneate-truncate on the lower side at the base. Pinnules very numerous, oblique, oblongo-lanceolate, ⅛–⅙ in. broad, cut half way down into close ascending lanceolate lobes. Veins one to each final lobe, with a small median sorus, with a glabrous reniform indusium. (*Baker, loc. cit.*)

DAVALLODES VISCIDULUM v. A. v. R.

Davallodes viscidulum v. A. v. R., Bull. J. B. Buitenz. 2 no. I (1911) 6.

Davallia viscidula METT. in Kuhn, Linnaea **36** (1869) 145.

Rhizoma deest; folia membranacea, siccitate rufescente-olivacea, infra tenuiter pubescentia, supra una cum rhachi breviter pubescente-viscidula; rhachis rufescens; lamina 1′ longa, late ovata, pinnatisecto-tripinnatifida; segmenta primaria sessilia, 7″ longa, oblongo-lanceolata, acuminata; laciniae primariae 1½″ longae, numerosae, approximatae, trapezio-oblongae, breviter acutae, ala angusta confluentes, secundariae oblongae, obtusae contiguae ala latiore confluentes, ultimae ovatae subfalcatae, acutae, nervum indivisum s. furcatum excipientes; sori terminales, ramo externo nervi superati; indusium ovatum, acutum margine parce ciliatum.

Java (Herb. Lugd. Bat. 1452.).

Indusio ovato ab *Davallia Borneensi* Mett. (*Lastrea* Hook. Icon. pl. t. 993. *Nephrodium* Hk. spec. IV p. 111.) recedens et potius cum *D. membranulosa* congruit, a quo vero statura gigantea, lamina enim ultra 1′ longa, differt."

Davallia viscidula Mett. var. *novoguineensis* Rosenstock,[3] "Paleis rhizomatis ciliatis, indusiis latioribus quam longis a typo diversa," is probably a distinct species.

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[3] Fedde's Repert **15** (1913) 526.

DAVALLODES KINGII Copel.

Davallodes Kingii COPELAND, Philip. Journ. Sci. § C 6 (1911) 147.

Davallia (*Leucostegia*) *Kingii* BAKER, in Hooker, Icones (1886) pl. 1622.

Rhizomate valido epigaeo lignoso longe repente, paleis patulis densis subulatis basi peltatis margine libero membranaceo, stipitibus erectis strictis nudis, frondibus oblongo-lanceolatis tripinnatifidis utrinque parce pilosis, rachi primaria pilosa utrinque anguste alata, pinnis lanceolatis infimis haud reductis, pinnulis oblongis adnatis profunde pinnatifidis, segmentis tertiariis contiguis oblongis, soris ad basin segmentorum solitariis, indusio ovato marginibus liberis.

Hab. Java, Mount Waringin, altitude 4,600 ft. *H. O. Forbes* (King 657).

Stipites semipedales. *Lamina* sesquipedalis, basi 9–10 poll. lata. *Pinnae* centrales et inferiores 4–5 poll. longae, 12–15 lin. latae.

A very distinct novelty, discovered in 1882 by Mr. H. O. Forbes when collecting in Java for Dr. King. It is most like the Philippine *D. ciliata* in habit, but differs totally in the structure of the indusium. (*Baker, loc. cit.*)

The wings of the rachis are questionably present on the plate which, except for the appearance of nakedness, looks exactly like *D. viscidulum*. From the statement that the new species is a very distinct novelty, and its comparison with nothing except the Philippine species, it is manifest that Baker was not conscious of the existence of *D. viscidulum* when he described this; and under these conditions he would of course have described it anew. *Davallodes Kingii* as such seems to have remained unknown since its first collection, and my belief is that it is *D. viscidulum*, the discrepancies in description being due to error, if not to variability.

DAVALLODES BORNEENSE (Hooker) Copel.

Davallodes borneense (Hooker) COPELAND, Sarawak Mus. Journ. 2 (1917) 336.

Lastrea borneensis HOOKER, Icones (1854) pl. 993.

Fronde pinnato pinnatifida (an bipinnata?) acuminata membranacea glabra, pinnis lanceolatis inferioribus longe anguste acuminatis profunde pinnatifidis, lobis oblongis acutis pinnatifido-serratis, lobulis serraturisve obtusiusculis, soris in medio venularum, involucris reniformi-orbicularibus venam centralem spectantibus, rachibus costisque pubescentibus.

Hab. Borneo, near Sarawak, *Thos. Lobb.*

. . . The veinlet on which the involucre is placed forms an angle at or near the middle, and from that angle the sorus and involucre appear to spring, . . . (*Hooker, loc. cit.*)

The frond, and more especially the indusia, have a marked reddish cast. I may be wrong in including under this name a fern much too firm in texture to be called membranaceous. The known range is Sarawak and Mount Kinabalu.

SPECIES DUBIA

Davallia (*Leucostegia*) *hosei* BAKER, Journ. of Bot. 26 (1888) 323.

Rootstock creeping, ⅛ in. diam., clothed with minute adpressed linear brown paleae. Stipes naked, brownish, 12–16 in. long. Lamina oblong-lanceolate, bipinnate, firm in texture, green and glabrous on both surfaces, 1½–2 ft. long, 5–6 in. broad. Pinnae distant, lanceolate, ascending, subsessile, ¾–1 in. broad, cut down to the rachis into unequal-sided oblong-lanceolate deeply crenate pinnules ⅛ in. broad, produced on the upper and cut away on the lower side at the base. Veins indistinct, one to each final lobe. Indusium as broad as long, rigid, glabrous, persistent, free at the sides.—Lambur, Sarawak, *Chas. Hose.* Allied to *D. Kingii*, *nephrodioides* and *ciliata*. (*Baker, loc. cit.*)

From the description, this would hardly be construed as a *Davallodes,* but it must be one if its affinities are correctly stated.

Failure to recognize *D. nephrodioides* and *D. Hosei* may be responsible for my belief that *D. borneensis* is a quite variable species.

Genus TROGOSTOLON Copeland, novum

Plate 4

Filix Davalliae affinis epiphytica, rhizomate late repente, paleis obscuris basibus nigris peltatis apicibus longe acicularibus rufescentibus squarrosis vestito; fronde deltoidea, glabra, in herbario subcoriacea, ad axes alatas quadri- vel quinquepinnatifida, segmentis ultimis angustis; soris quoad venam insessam abortivam terminalibus nec non saepius axillares simulantibus, utrinque vel unilateraliter cornu acuto falcato laminae excelsis; indusio firmo sed tenue, plus minus orbiculare, basi late adnato alibi libero.

Named for the resemblance of the bristly rhizome to a caterpillar.

Type and sole known species:

TROGOSTOLON FALCINELLUS (Presl) Copel. Plate 4.

Davallia falcinella PRESL, Rel. Haenk. 1 (1825) 66, pl. 11, f. 2. Philippines, from Central Luzon to Mindanao. Common in the Visayan islands.

There is considerable variation among the specimens in hand, but it is not clear that the differences characterize locally established forms or species. On some specimens minute white hairs, making the bristles of the rhizome ciliate, are conspicuous under the lens; on others these can hardly be detected and are very nearly absent. The accompanying table of generic characters shows the distinctions between this and the other genera of the group, and the several items of resemblance, as well as any discussion would do this.

Genus LEUCOSTEGIA Presl

Leucostegia PRESL, Tent. Pterid. (1836) 94.

Presl's diagnosis was in effect a description of one species, and incorporated the idea that its upper and lower surfaces have the aspect of being reversed. The type is *L. immersa.* Strikingly similar to it in color, size, dissection, habitat, and various other features is *Davallia pallida* Mett., a fern different from any other *Davallia* in habitat, paleæ, texture, texture of indusia, etc.—a clearly foreign element in *Davallia,* in spite of the fact that the sides of the indusium are affixed. It is like *L. immersa* in every respect in which it is unlike all true species of *Davallia.*

Having already in this group of genera one, *Davallodes,* with diverse indusia, I propose to enlarge the concept of *Leucostegia,* to include these two species. Each is more nearly related to the other than to any other known species. If *D. pallida* were not made a *Leucostegia,* the only proper alternative would be establishment for it of a new monotypic genus; and in my opinion its affinity to *Leucostegia* is too close and real to justify that course.

The generic characters are:

Davallioid ferns with stout, creeping rhizomes clothed with broad scales which are not black, nor aciculate nor ciliate; stipe long, light-colored, imperfectly articulate; frond ample, pinnately decompound, with broad, glabrous, herbaceous, pale green ultimate pinnules; sori dorsal in origin, but with very large pale, thin but firm indusia which may reach or surpass the margin. Normally terrestrial.

LEUCOSTEGIA IMMERSA (Wall.) Presl.

Leucostegia immersa (Wall.) PRESL, Tent. Pterid. (1836) 95.
Davallia immersa Wall., HOOKER, Spec. Fil. 1 (1846) 156.

Pinnules in general rhomboidal in outline, toothed; indusium reniform, free except for the middle of its base. Where first known, in northern India, it is a fern of moderate size, 20 to 40 cm high. A doubtfully distinct, very thin dwarf form with huge sori, not uncommon on the mountains of northern Luzon, is my var. *nana.*[4] The very large form commoner in the Philippines and Celebes is var. *amplissima* Christ.

LEUCOSTEGIA PALLIDA (Mett.) Copel., comb. nov.

Davallia pallida Mett., KUHN, Linnaea 36 (1869) 142.

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[4] Philip. Journ. Sci. 1 Suppl. (1906) 147.

Pinnules in general cuneate-obovate, with a few sharp incisions; indusium cup-shaped with sides affixed, but a broad, flaring free upper part, commonly equaling the margin. Of such size as the var. *amplissima* of the preceding species.

Range, Borneo and Mindanao to Samoa.

The resemblance of these two species, however different their indusial attachment, did not escape Kuhn: "*Davalliae immersae* proxima, quae vero indusio reniformi ad latera libero gaudet."

Genus HUMATA Cavanilles

Humata CAVANILLES, Descriptiones Pl. (1802) 272.

The essential characters of this genus have been shown in the preceding outline of genera, and a study of the species is not undertaken here. I do not know the grounds on which Christensen, Index p. XXVII, selects *Adiantum repens* L. fils, as the type of the genus. To me it seems to be *H. ophioglossa* Cav., which is now construed as being *H. heterophylla* (Smith) Desv. *Humata trifoliata* Cav., construed as *H. repens* (L. f.) Diels, was the third and last species listed by Cavanilles. This question of identity of type has eventual importance because the genus can be divided into two groups of species, of which each contains one of the two suggested types.

Humata reaches its richest development in species in New Guinea, and is well represented in Polynesia and Malaya. A single species, *H. repens,* reaches to India and Japan.

Genus DAVALLIA Smith (1793)

This is the commonest, richest in species, and most widespread genus of its group, and was the first to receive generic recognition. It is therefore quite natural that it has been chosen to provide a name for the tribe or family of which it is a member. As in the case of *Humata,* its characters have already been indicated sufficiently, and I have not at hand material enough to justify a comprehensive discussion of the species. Its type is *Davallia canariensis* (L.) Sm., *Trichomanes canariense* L., a species of the Canary Islands and other islands and the mainland in the same region. The greatest wealth of species is in the Malay Region.

Judging by geographical distribution, it would seem likely to be the oldest genus of its group; it ranges from the islands of the Atlantic, across Africa, southern Asia and Malaya, to Japan, Australia, Kermadec, and Samoa, probably without a break except where fit conditions are wanting for epiphytic life. I believe, though, that there is another, and in this instance more correct, explanation of its wide range. It is a genus very perfectly adapted to epiphytic existence without restriction to situations of great or constant humidity. In ability to thrive as an epiphyte exposed to the sun, it surpasses *Humata* in protection of the young sporangia, *Scyphularia* in that of the rhizome, and the other genera more decidedly in texture. My opinion is that these advantages have enabled it to spread farther than the other genera, without the necessary use of more time.

The confusion with it, in the history of the genus, of ferns as remote in natural affinity as *Leptolepia, Tapeinidium, Balantium,* and *Prosaptia* is a good demonstration of the natural result of dependence upon a few arbitrarily selected criteria for the purpose of general classification.

Genus SCYPHULARIA Fée

Scyphularia FÉE, Genera (1850–1852) 324.

The distinctive characters of this genus have already been made clear enough. Its nearest affinity is quite certainly to *Davallia,* but the paleæ and the undissected fronds make it decidedly expedient to remove it and leave *Davallia* without any considerably aberrant group. While the bristles of *Scyphularia* have been figured without cilia, and usually appear so under the lens, a careful study, at least in many cases, will show white or pale fibers on the paleæ, quite like those conspicuous on the paleæ of *Davallia.* The occasional forking of the lowest pinnæ is another evidence of affinity to the other genera with thick fronds.

Scyphularia ranges across the central and southern Malayan Region to as far east as Fiji. It is not known in the Philippines.

Key to species of Scyphularia.

1. Fronds pinnate.
  2. Sori long, occupying a considerable part of the lamina.
    3. Margin entire, or sori on the teeth.
      4. Margin entire or simply toothed .... 1. **S. pentaphylla.**
      4. Margin doubly toothed .... 2. **S. pycnocarpa.**
    3. Margin toothed, the sori between the teeth .... 3. **S. sinusora.**
  2. Sori short, in a marginal band .... 4. **S. triphylla.**
1. Fronds simple .... 5. **S. simplicifolia.**

SCYPHULARIA PENTAPHYLLA (Bl.) Fée.

Scyphularia pentaphylla (Bl.) FÉE, Genera (1850–1852) 325.
Davallia pentaphylla BLUME, Enum. (1828) 232.

D. fronde ternata vel quinato-pinnata coriacea glaberrima, pinnis lanceolatis basi cuneatis inaequaliter serratis, fertilibus (ternatis) angustioribus elongatis, soris oblongis truncatis marginalibus, stipite glabro, caudice repente paleaceo-crinito . . . in sylvis Javae Provinciarum Bantam, Tjanjor etc. (*Blume, loc. cit.*)

As now construed, this species may have from one to five pairs of lateral pinnæ, with the basal ones simple or forked. The sori are large and long, the base commonly less than halfway from the costa to the margin. In Steere's Ternate collection, the base is close to the costa, so that they occupy almost the whole width of the pinnæ. It will probably be found, eventually, that several species have been given this name.

SCYPHULARIA PYCNOCARPA (Brack.) Copel., comb. nov.

Davallia pycnocarpa BRACK., U. S. Expl. Exped. 16 (1854) 242, pl. 35, f. 2.

D. rhizomate repente crinito-paleaceo; stipitibus nudis semiteretibus; frondibus deltoideo-ovatis coriaceis glabris quinato-pinnatis; pinnis subsessilibus, sterilibus lanceolatis serrulatis, fertilibus lineari-lanceolatis obtusis, infimis uni-bilobatis margine duplicato-dentatis a basi usque ad apicem creberrime soriferis; indusio oblongo apice truncato; sporangiis subexsertis; venis immersis simplicissimis vel furcatis.

Hab. Muthuata Mountains, Feejee Islands: on rocks and trunks of trees.

. . . Fronds . . . constantly quinate-pinnate; the height of the fertile one, with the stipes, from 6 to 8 inches . . . Closely related to the preceding (*D. pentaphylla*); yet distinct from it in the smaller quinate fronds, the narrower pinnae, with a doubly-toothed margin soriferous the whole length, and in the shorter and more cup-shaped indusium. (*Brackenridge, loc. cit.*)

Subsequent authors have agreed in reducing this to *S. pentaphylla,* and the differences are really not very convincing. Still, the alert collector can be expected to judge identity or difference more competently than can the herbarium worker. I have a stronger suspicion that Brackenridge erred in his determination of *S. pentaphylla* than that *S. pycnocarpa* is that species.

SCYPHULARIA SINUSORA Copel., sp. nov. Plate 5.

Species S. pentaphyllae affinis, rhizomate admodum gracile, paleis aciculatis ciliatis castaneis in vetustate cinereo-nigrescentibus glabrescentibus vestito; frondis sterilis unicae visae stipite 2 cm alto, gracile, sulcato, fronde 4.5 cm alta, triangulari-ovata, rhachi cartilagineo-alata; pinnis utroque latere duo cum impare majore, subsessilibus, oblongis, 1 cm latis, apices versus minute serratis, coriaceis, glabris; frondis fertilis stipite 5 cm alto, fronde 12 cm alta, paullo latiore; pinnis 5, late linearibus, 1 cm latis, acutis vel acuminatis, basi inaequaliter cuneatis, serrato-dentatis, venis immersis; soris inter dentes, 2 mm longis, labio libero indusii breve, quam truncato potius rotundato.

Papua, Goodenough Bay, altitude 1,200 m. s. m. *Copeland King* No. 183 (1908).

Distinguished by the regularly obliquely dentate margin of the fertile frond, with the sori regularly placed between the teeth. Specimens regarded as *S. pentaphylla* vary from entire to coarsely toothed; but, when teeth are evident, the sori are placed on, not between, them. Absolutely, and in proportion to the part of the space between midrib and margin which they occupy, this has shorter sori than *S. pentaphylla* without, however, any near approach to their restriction to a marginal band, as in *S. triphylla*. The marked dimorphism may be peculiar to my specimen, rather than to the species; but the position of the sori may be expected to prove a dependable specific character. The paleæ, while they are still castaneous in mass color, are more ciliate than in any other *Scyphularia* I have seen, and are rather less abruptly contracted above the peltate base.

SCYPHULARIA TRIPHYLLA (Hooker) Fée.

Scyphularia triphylla (Hooker) FÉE, Genera (1850–1852) 325.

Davallia triphylla HOOKER, Spec. Fil. 1 (1846) 162, pl. 46 A.

Caudex stout creeping covered with chaffy scales, fronds coriaceous small ternate, pinnae oblong-lanceolate obtuse cuneate at the base in fertile plants more elongated all of them entire, intermediate ones petiolate, lateral ones shorter sessile oblique at the base, veins horizontally patent copious crowded parallel forked thickened flat (not prominent), involucres semicylindrical compressed crowded so as to form an uninterrupted marginal line the whole length of the pinnae . . .

Hab. Singapore, *Cuming n.* 366 . . .—Caudex with closely imbricated paleaceous scales, having long wiry points. Stipes 3–4 inches long, terminal pinna 4–5 inches long. (*Hooker, loc. cit.*)

SCYPHULARIA SIMPLICIFOLIA Copel.

Scyphularia simplicifolia COPELAND, Philip. Journ. Sci. § C 7 (1912) 64.

Frondibus simplicibus, 15 ad 25 cm altis, 35 ad 45 mm latis, fertilibus obscure crenulatis, sterilibus integerrimis, venulis haud crassis, soris 2 ad 3 mm longis, linearibus, aliter ut S. triphyllae Fée.

Sarawak, Santubong Mountain, alt. 600 m, scandent, *Brooks 133*, Oct., 1909. (*Copeland, loc. cit.*)

Still known only from the original collection.

ILLUSTRATIONS

PLATE 1

Araiostegia hymenophylloides (Blume) Copeland; *a*, entire plant; *b*, pinnule, × 5.

PLATE 2

Araiostegia yunnanensis (Christ) Copeland; *Cavalerie 7010.*

PLATE 3

FIG. 1. *Davallodes laxum* Copeland; fragment of type, × 5.
2. *Davallodes congestum* Copeland; type.

PLATE 4

Trogostolon falcinellus (Presl) Copeland; *Elmer 7066.*

PLATE 5

Scyphularia sinusora Copeland; type.

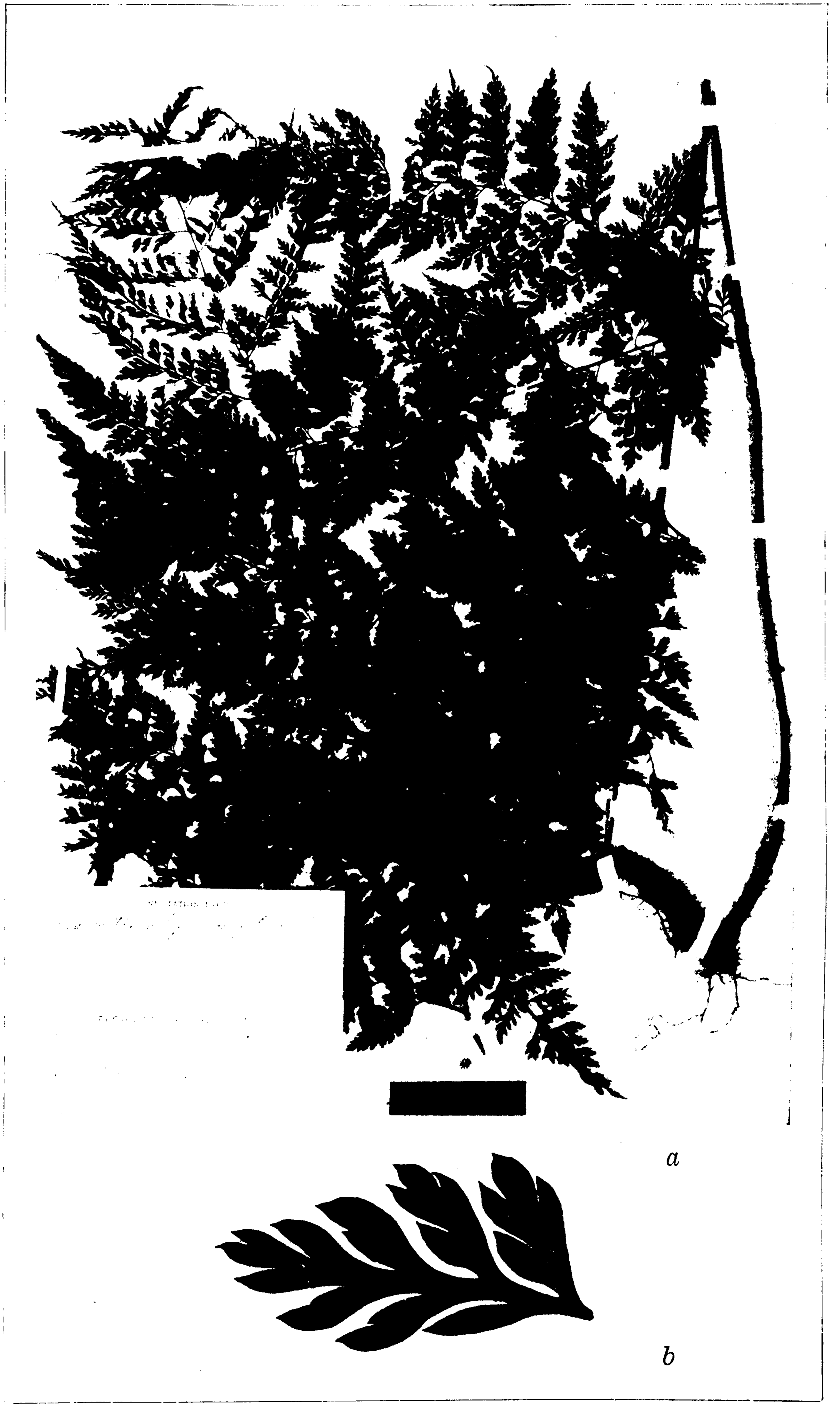

PLATE 1. ARAIOSTEGIA HYMENOPHYLLOIDES (BLUME) COPELAND.

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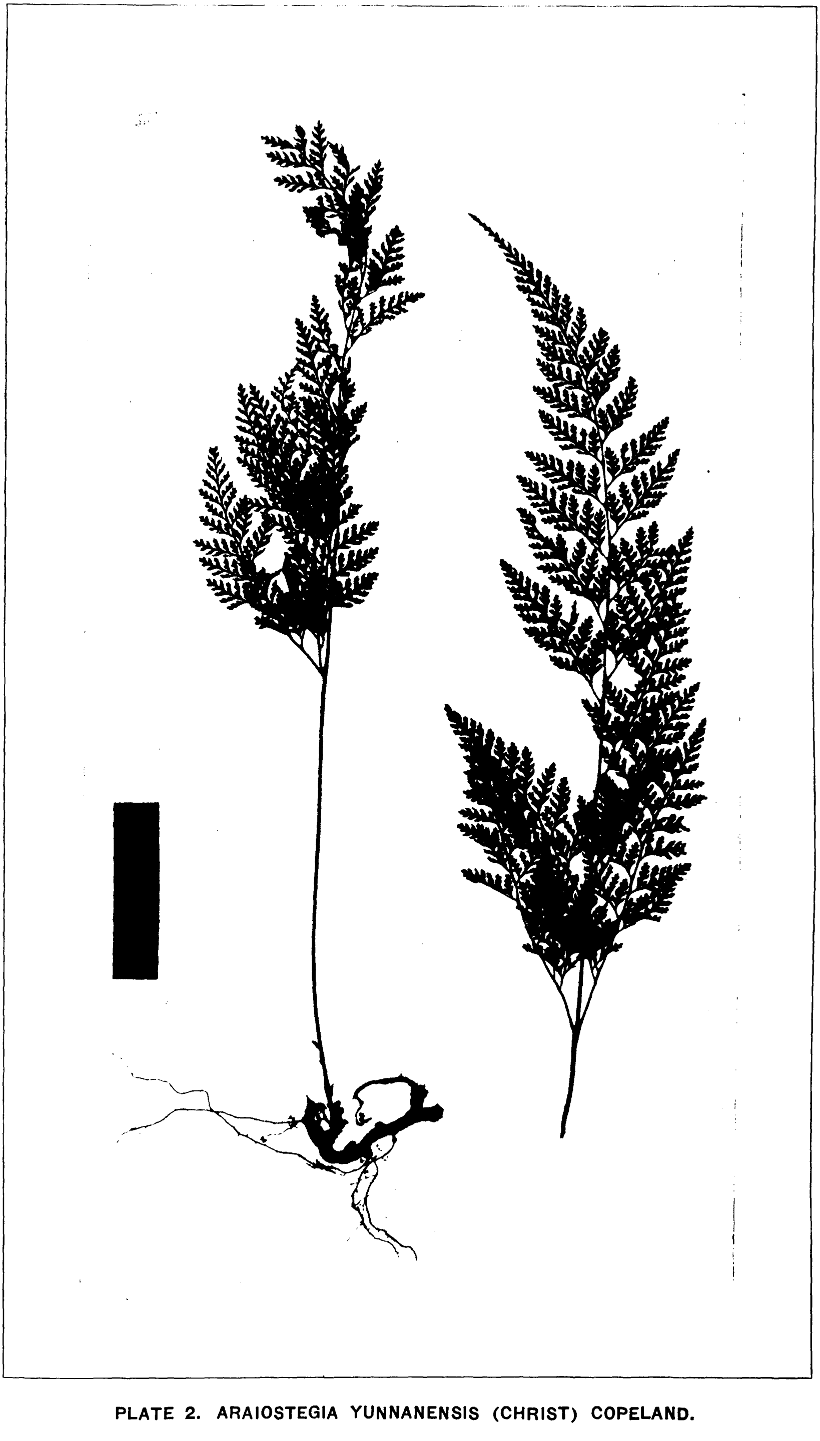
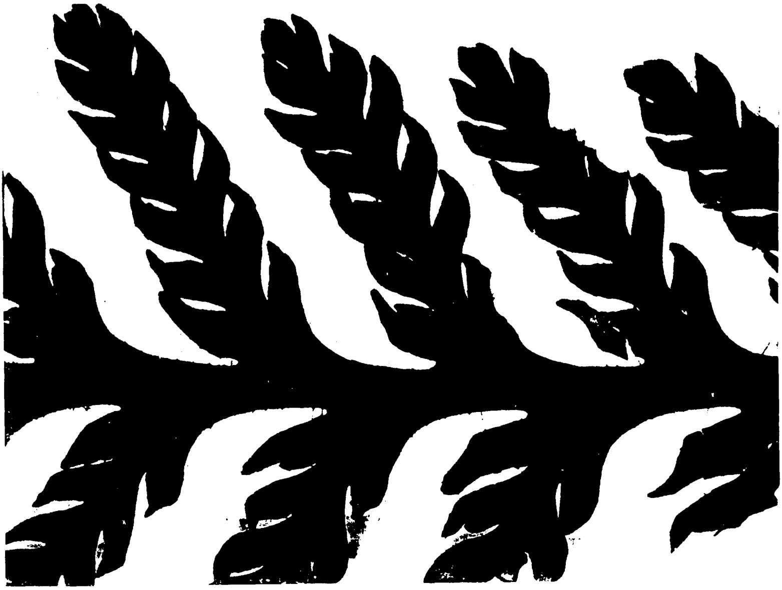


PLATE 2. ARAIOSTEGIA YUNNANENSIS (CHRIST) COPELAND.



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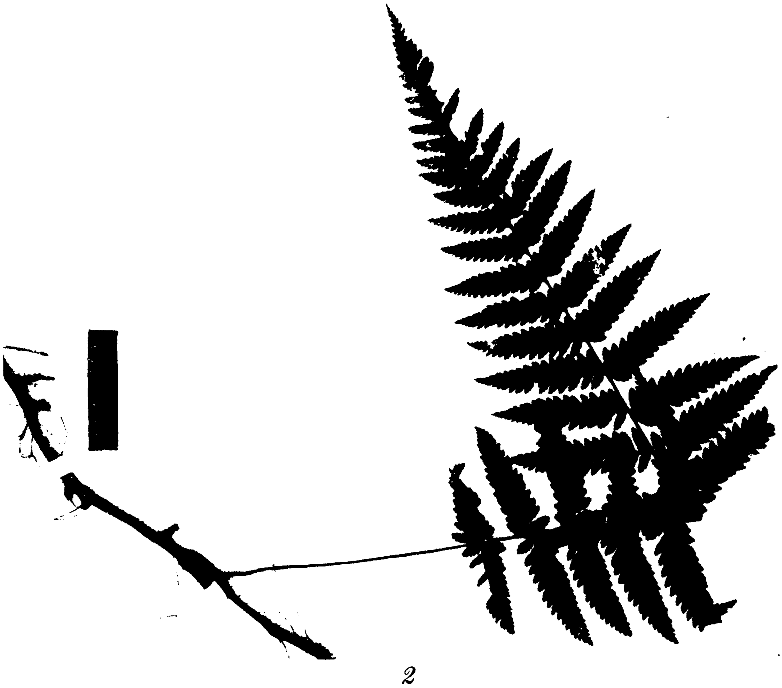

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PLATE 3.

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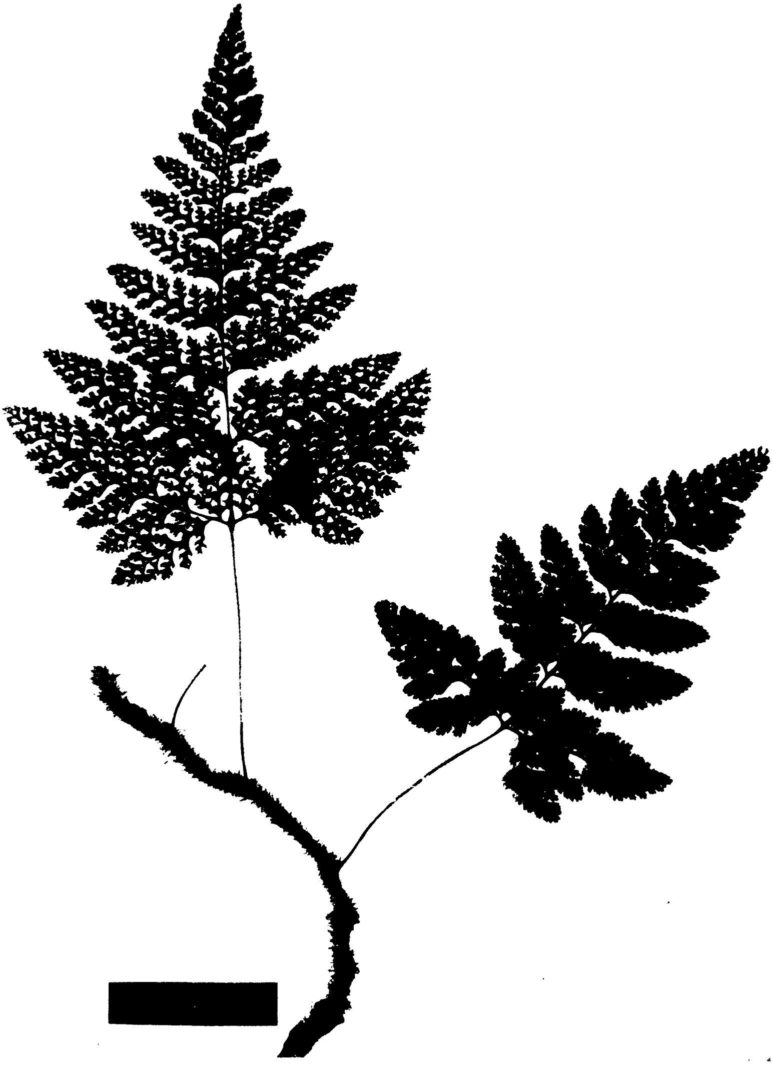

PLATE 4. TROGOSTOLON FALCINELLUS (PRESL) COPELAND.

MICH.

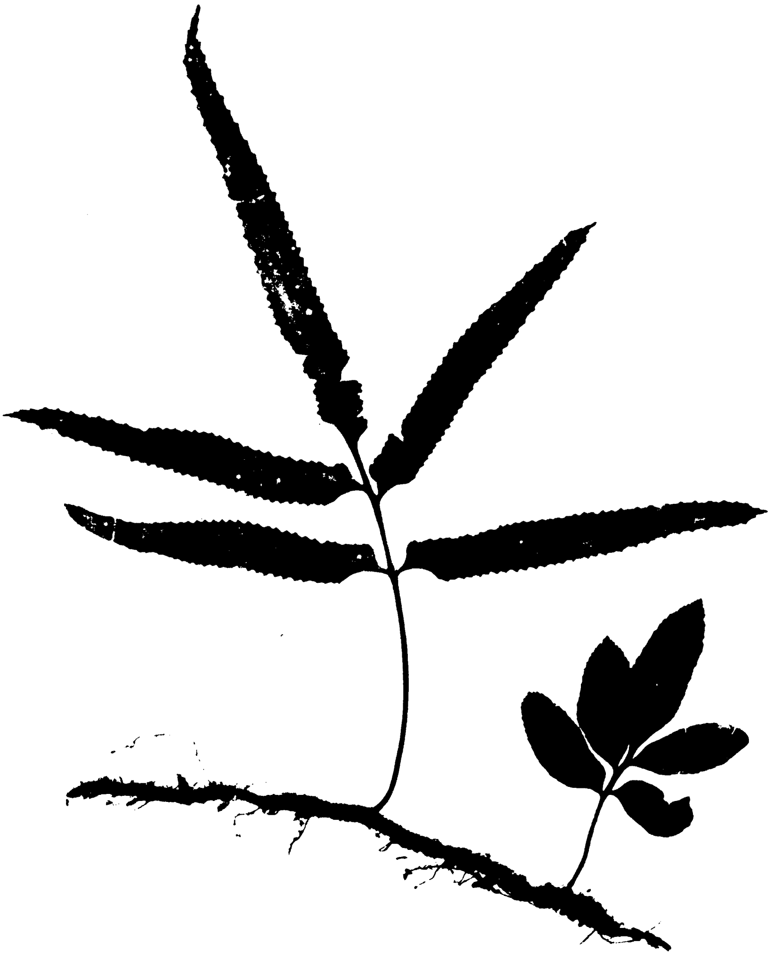

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PLATE 5. SCYPHYLARIA SINUSORA COPELAND.

THE GENUS CALYMMODON

By Edwin Bingham Copeland
Of Chico, California

SIX PLATES

The genus *Calymmodon* was established by Presl,[1] as a segregate from *Polypodium* or *Grammitis,* in appreciation of the peculiar folding of the side or sides of the lobe or pinna as a protection for the sorus. For a type, he cites *Polypodium cucullatum* Nees and Blume. Evidently, he never saw the fern, for he states explicitly that he drew the diagnosis from Blume's figure. A very good figure accompanied the description of *P. cucullatum* Nees and Blume; but a very few years later Blume undertook to relocate the fern, as *Grammitis cucullata,* and published a new figure. The two figures do not seem to represent the same fern; and it was almost surely from the second one that Presl made his diagnosis. The two ferns are at any rate congeneric.

Diagnosis.—A genus of grammitid (?) ferns, of small size, epiphytic on mossy trunks in moist woods, the rhizome or caudex short, scaly, and beset with stipes and roots, the stipes not articulate; fronds pinnatifid to a winged costa or eventually pinnate, membranaceous or herbaceous, clothed with fine, pale hairs or nearly or quite glabrous, each segment with a single unbranched vein, on which the solitary sorus is borne below the apex; the sorus protected against water by the folding over it of the lower or both sides of the segment, exindusiate.

While the protection of the sorus is the conspicuous character to which the genus owes its name, the form, texture, pubescence if any, habit, and habitat are no less characteristic. It is a thoroughly natural group. There are other polypodiid ferns like these in form of frond, and even in venation, but they differ in texture and pubescence, and have distinct affinities.

Calymmodon is a distinctly Malayan genus, reaching out, as far as is now known, to Ceylon, Samoa, and Luzon. Let it be assumed that the pinnate *Eu-Polypodium* is a monophyletic group of world-wide distribution, and that *Grammitis* is a similar group well represented in the Tropics of both hemispheres. Both are large groups, each with a variety of minor groups of more-restricted occurrence. Almost certainly, both groups are far older than *Calymmodon* which, therefore, cannot be a link between them. If it is descended from either group, as is exceedingly probable, it is not related to the other except through that one. Its parentage is to be sought among similar ferns, of the same region, of similar habitat. Each group presents such possible parents. Blume, when he classed one of these ferns as a *Grammitis,* suggested his *G. subpinnatifida* as representing what we would now call the line of evolution; and it may so do.

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[1] Tentamen Pterid. (1836) 203.

Calymmodon, as here construed, is the present end of a line of evolution. When I described the genus *Acrosorus,* I regarded it as derived from *Calymmodon,* but I now believe it can be traced back to an independent source. They have therefore to be regarded as independent generic entities, or included with their parents in a very comprehensive genus. As to this, one's choice is free—to include both of these, and *Aglaomorpha,* too, in *Polypodium.* Some library botanist will of course transfer the new species of *Calymmodon* to *Polypodium;* but the time is not far off when sane botanists, in herbarium and field, will agree that, just as fast as definable monophyletic groups of reasonable size and character can be recognized, it will be better to regard them as genera than to use them to maintain such a monstrosity as *Polypodium* has become.

As a matter of definition, *Polypodium* has articulate stipes; *Calymmodon* has not. There are many species left in *Polypodium* with nonarticulate stipes; but none, so far as I know, in which the failure of the leaf to break away is quite so flagrant. In at least some of the *Calymmodon* species, the axis of the frond remains in place while all the soft parts rot and fall away, apparently having done so for decades, for the mossy forest is not a place for rapid growth. The countless, stiff, tough spines, which thus remain as an envelope of the stem, help to collect and hold the débris which helps out the plant's naturally scanty supply of mineral food, and the mosses, liverworts, algæ, etc., which collectively maintain the humidity of the mossy forest.

Key to the species of Calymmodon.

1. Fertile segments wide to the base.
  2. Segments remote, or fronds nearly naked.
    3. Wing of costa very narrow.
      4. Sterile lobes toothlike or narrow.
        5. Paleæ large, up to 5 mm long.
          6. Fronds 3–6 mm wide.. 1. C. **cucullatus.**
          6. Fronds under 2 mm wide........................ 2. C. **pergracillimus.**
        5. Paleæ hardly over 2 mm long.
          6. Fertile segments narrowly adnate.................. 9. C. **ordinatus.**
          6. Fertile segments very broadly adnate........ 3. C. **glabrescens.**
      4. Sterile lobes obovate, blunt.. 4. C. **hyalinus.**
    3. Costa conspicuously winged.
      4. Sterile lobes broad, approximate.
        5. Paleæ scant and short.. 5. C. **muscoides.**
        5. Paleæ copious and long.. 6. C. **latealatus.**
      4. Sterile lobes narrow, remote............................ 7. C. **hygroscopicus.**
  2. Segments approximate, fronds hairy................................ 8. C. **gracilis.**
1. Fertile segments contracted below sori.
  2. Hairs pale or tawny.
    3. Contraction moderate.
      4. Sterile segments oblong.. 9. C. **ordinatus.**
      4. Sterile segments oblanceolate.................................. 10. C. **Mnioides.**
    3. Fertile part conspicuously stalked.............................. 11. C. **clavifer.**
  2. Hairs dark.. 12. C. **conduplicatus.**

CALYMMODON CUCULLATUS (Nees and Blume) Presl.

Calymmodon cucullatus (Nees and Blume) PRESL, Tentamen Pterid. (1836) 204.
Polypodium cucullatum NEES and BLUME, Nova Acta 1 (1823) 121.
Polypodium gracillimum COPEL., Perkins' Fragmenta (1905) 189.
Polypodium subgracillimum v. A. v. R., Bull. Jard. Bot. Buitenzorg II No. 7 (1912) 40.

The diagnosis of this species was drafted by Nees; which author wrote the explanatory description is not stated. They read:

P. frondibus pinnatifidis glabris erectis linearibus, laciniis inferioribus lanceolato-dentiformibus acutis decurrentibus, superioribus ovatis obtusis cucullato-complicatis fertilibus, soro solitario.

Descr. Frons tri-quadripollicaris, angusta, linearis, adscendens, profunde pinnatifida. Stipes brevissimus, anceps, glaber, crassitie fili lintei. Laciniae alternae, 1–1½ lin. longae, inferiores e basi decurrente acutae, lanceolato-triangulares, planae, nervo medio instructae, erecto-patentes, steriles, quarum infimae minimae, dentiformes; superiores, a media fronde, fertiles, reliquis breviores sed duplo latiores, alternae, subsecundae, ovatae, obtusae, complicato-concavae et cucullatae, sorumque solitarium multicapsularem mediae costae ad basin insertum in fundo occultantes. Capsulae parvae, annulo ¾, brevi petiolo instructae. Indusium nullum.

Habitat prope *Ripanna*, Javae Insulae.

The accompanying illustration shows two entire fronds, somewhat exceeding the dimensions stated in the description, and a magnified portion showing six fertile segments, so accurately drawn that one who knows the behavior of the fern can see that the specimen was put into the press when dry enough to permit the spores to scatter. It even shows, as the description fails to do, that the lamina is very thin. The only error is Nees' statement that the fronds are erect; they may be, on the herbarium sheet. On the trunk of a tree, they stand out at first, and become pendent when at all long.

This is the most widespread and locally variable member of the group. In its fullest development, the fronds reach a width of at least 8 mm, and 6 mm is common in its ample form. The sterile segments are then linear-oblong, over 4 mm long and fully 1 mm wide, broadest above the middle, equal-sided except at the base, and rounded, obtuse or acute at the apex. The "typical" form, in the sense that the type is the thing described as a new species, has repeatedly been very much narrower, with the sterile lobes shortened until their form is dominated by the decurrent base. They are then obliquely triangular, or toothlike if somewhat longer, and always acute. This contraction may be so extreme that fronds 10 cm long are nowhere much more than 2 mm in width.

In the narrow forms, the fertile and sterile parts of the frond are similar in width. The fronds taper toward both ends, and the broadest region is likely to be about where the fertile and sterile portions meet. The costa is very narrowly winged, the decurrent base of each lobe almost disappearing before it connects with the next lobe below. The lobes are commonly separated by somewhat more than their own width, sometimes by twice this. The frond may be apparently glabrous or, especially on the costa, there may be inconspicuous pale, tawny hairs. The more ample form is likely to be more hairy. On a single plant, the leaves are usually fairly uniform—all more or less narrow, with pointed lobes, or all broader, with symmetrical lobes; but, wherever any form is common, all forms, from the narrowest to the widest, may be expected. I have collected them together on Apo, back of San Ramon, on Banahao, and on Pulog, and the Owen Bryant Expedition did the same on the Gedé.

In the mossy forest, throughout the Malay region.

CALYMMODON PERGRACILLMUS (v. A. v. R.) Copel., comb. nov. Plate 1.

Polypodium pergracillimum v. A. v. R., Bull. Jard. Bot. Buitenzorg II 20 (1915) 23.

Eupolypodium, Pinnatifida.—P. subgracillimo v. A. v. R. affine sed frondibus angustioribus, ca. 1–2 mm latis, segmentis sterilibus oblique brevi-deltoideis, decurrentibus, apice recurvatis. (*v. A. van Rosenburgh, loc. cit.*)

Dutch New Guinea.

A specimen collected by C. Boden Kloss, the subject of the accompanying Plate 1, is confidently referred to this species. The rhizome is notably long, and the aggregation of fronds correspondingly dense. The sterile teeth are a fraction of a millimeter wide, separated by many times their own width, and connected by an almost obsolete wing. To provide a place for a sorus, and any lamina to fold up beside it, the fertile segments are necessarily much larger than the sterile; but even these are as small as they well can be. The paleæ are like those of *C. cucullatus,* or somewhat broader—so large that they are evident in the photograph (X).

CALYMMODON GLABRESCENS Copel., sp. nov. Plate 2.

Caudice parva, paleis ferrugineis 2 mm longis 0.5 mm latis apiculatis basibus auriculato-cordatis inter radices et baseos stipitum vestito; stipitibus dense caespitosis, brevibus, aut usque aut fere ad caudicem angustissime alatis, rhachibusque pilis albidis minutis paucis et caducis ornatis; fronde 6–10 cm alta, 7– (rarius) 10 mm lata, herbacea, pilis brevissimis plerisque mox caducis ornata; segmentis sterilibus oblongis, obtusis vel apice rotundatis, plerumque ca. 4 mm longis, 1.3 mm latis, spatio aequilato separatis, basi late adnatis, decurrentibus et ala angusta connexis; segmentis fertilibus brevioribus, latioribus at latius ad alam latiorem adnatis.

Ceylon. Beckett No. 265. Type, in Herb. Kew. On trees, altitude 900–1,800 m. s. m.

This is nearer to the real *C. cucullatus* than to any other species. It bears no hairs as long as those of which that species often has a few, but may bear more numerous, very minute ones. It shows no sign of the narrow form with tooth-like segments, and is not so lax nor so elongate as the more ample form of *C. cucullatus;* and the fertile segments are relatively shorter and more rounded. The most outstanding single difference is in the paleæ, those of *C. cucullatus* being more than twice as long and rather paler. None of the two dozen plants sent me is nearly as hairy as is represented by Beddome's diagrammatic figures; and the resemblance to *C. gracilis,* rather than to *C. cucullatus,* suggested by his sketch and description, does not really exist.

CALYMMODON HYALINUS Copel., sp. nov. Plate 3.

Caudice vix 0.6 mm crasso, paleis ferrugineis aequilatis lanceolatis vestito; stipitibus confertis, usque ad 5 mm longis, nigrescentibus, sparse pilosis fronde vix 5 cm longa, 7 mm lata, ad alam angustam pinnatifida, praecipue ad costam sparse pilosa, membranacea; lobis sterilibus anguste obovatis, usque ad 1.5 mm latis, spatio angustiore separatis, apicibus late rotundatis; fertilibus paullo brevioribus, similiter latis et rotundatis, et siccis conduplicatis.

Sarawak, Mount Bengkarum, altitude 1,050 m. l., C. J. Brooks (1908).

Mr. Brooks sent this to me with the note that he could identify it with no known species, but I mistook it then for *C. cucullatus.* It is most like *C. gracilis,* but differs in being less hairy, with relatively broad lobes and narrow wing along the costa, as well as in size. Small as the fronds are—and the diagnosis fits the largest seen—the specimens are fruiting freely. The caudex is less buried in old stipes and rachises than in other known species. In hairiness and in the vanishing wing, this is very like *C. cucullatus,* but differs in having the lobes comparatively broad and close together.

CALYMMODON MUSCOIDES Copel.

Polypodium muscoides COPEL., Elm. Leafl. Philip. Bot. 3 (1910) 839.

The original description reads:

> P. gregis P. cucullati, minutum; rhizomate breve, erecto; stipitibus brevibus, confertis, haud articulatis; fronde usque ad 5 cm (plerumque ca. 3 cm) longa, 3 mm lata, ad costam alatam in segmenta ob partes inferiores infraflexas triangularia 1 mm lata proxima pinnatifida; soro solitario, more P. cucullati protecto.
>
> Mount Apo, altitude 2,150 m., forming dense soft patches at the base of mossy trunks.

I have in hand only Elmer's type collection, but have once identified a Kinabalu plant as the same. The fronds are uniformly small, dark green, rather stiff, chiefly because of the hard but very fine costa, sparsely clothed when young with minute hairs, whitish like those of *C. gracilis* but incomparably smaller. The sterile segments (cf. diagnosis) are of course not folded; the lowest are toothlike; the others also are quite oblique, short-oblong when most ample, rounded or subacute, and separated by less than their own width. Van Alderwerelt's figure of them[2] is good. The rhizome is densely beset with stipe-bases and roots, and longer remnants of stipes and rachises. If these are dissected away, a few minute, fuscous scales are found, a fraction of a millimeter long, and apparently broadly lanceolate. The sori are large enough to fill and protrude from the cavity of the folded fertile segments.

CALYMMODON LATEALATUS Copel., sp. nov. Plate 4.

Rhizomate gracile, paleis castaneo-ferrugineis lineari-lanceolatis 2 mm longis vestito; frondibus subsessilibus, linearibus, 4–7—et usque ad 25—cm longis, 3–4 mm latis, ad alam latam costae pinnatifidis, herbaceis, pallide viridibus, pilis brevissimis sparsissime pilosis et ciliatis; segmentis sterilibus obliquis, infimis breviter serraeformibus, sequentibus approximatis breviter oblongis subrotundatis; fertilibus haud reductis, dum modo expansis imbricatis, soro lamina ampla occulto.

Apia. No. 107 of the Praeger Herb. Type in Herb. Calif. Acad. Sci. Collected Aug. 6, 1880, presumably by Betsche (largest fronds 7 cm long); much larger specimens in Kew herbarium, collected in Samoa by Horne, and by Powell. Also, Horne No. 1026, apparently from Fiji.

Very similar to *C. muscoides*, but distinctly lighter in color, the costa more broadly winged, the pubescence still more minute, and particularly distinguished by the scaliness of the rhizome. Both species appear glabrous until carefully studied.

CALYMMODON HYGROSCOPICUS Copel., sp. nov. Plate 5.

Caudice gracile, 1–1.5 mm crasso, more generis stipitibus, rhachibus frondium emortuarum et radicibus profunde tecto, paleis fusco-ferrugineis sat grandibus ad apices lobuliferis et ibidem barbatis vestito; frondibus densissime glomeratis, stipitibus, si tales distinguendi sunt, 1 cm longis, fere ad caudicem alatis; fronde 6–9 cm longa, 5 mm lata, ad alam conspicuam pinnatifida, glabra, herbacea; lobis sterilibus oblongis, 1–1.3 mm latis, obtusis, inter se 1.5 mm distantibus; fertilibus gradatim abbreviatis, infra soros non angustatis; soro mediale, interdum venulam secus subelongato.

Papua, "behind Wedan," King No. 475.

The wing along the costa is distinctly wider than in most species, but still not as wide, in proportion to the size of the frond, as in *C. muscoides*, from which it differs essentially in the elongate lobes. These are broader and less remote than in *C. cucullatus.* The texture is more substantial than in other species.

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[2] Bull. Jard. Bot. Buitenzorg II 7 (1912) pl. 3, fig. 3.

POLYPODIUM CALYMMODON v. A. v. R.

Polypodium Calymmodon v. A. v. R., Malayan Ferns Suppl.

I give this a place here because I do not know how to reduce it to any other species, and may not ignore what is seriously presented in as useful a work as van Alderwerelt's. The plant, if such there be, is distinct from all others of its group, in having the fertile segments distinctly longer than the sterile. For this distinction, a drawing by "Sixtus" [3] is the sole authority, unsupported by Blume's text. Nevertheless, van Alderwerelt presents a full description of a plant, and endows it with a name, "*Polypodium Calymmodon* Fée," without citation of its source. Fée's diagnosis, which van Alderwerelt explains that he did not see, hardly existed. Fée had previously described the hairy Philippine relative as *Plectopteris gracilis.* He then [4] rechristened *Polypodium cucullatum* Nees and Blume, citing the synonyms up to his time, as *Plectopteris Calymmodon.* He had no more seen the fern in question than had Presl; but he distinguished it from his *P. gracilis* thus: "Fronde pinnatifide, coriace, à segments fertiles unilatéraux; les fertiles six fois plus petits que les stériles." Thus a manifestly inaccurate picture (for the fertile segments in the picture of "*Grammitis cucullata*" are like nothing in nature), unsupported by text, made by an otherwise unknown penman, which never did represent a distinct plant except on the assumption that Blume misconstrued his own species, has given rise to a library species, characterized by very large fertile lobes, but equipped with a name invented for another library species with freakishly small ones. Requiescat in pace.

CALYMMODON GRACILIS (Fée) Copel., comb. nov.

Plectopteris gracilis FÉE, Genera Fil. (1850–1852) 230.

Calymmodon hirtus BRACK., U. S. Expl. Exped. 16 (1854) 2.

Polypodium consociatum v. A. v. R., Bull. Jard. Bot. Buitenzorg II 7 (1912) 41.

Polypodium cucullatum of many writers, not of Nees and Blume.

Fée distinguished this from Blume's plant, his *P. Calymmodon,* by thinner texture, hairiness, and fertile segments slightly

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[3] Blume, Flora Javae 2, pl. 50, f. 3.

[4] Huitième Mémoire (1857) 124.

smaller than the sterile. For substantially the same reasons, Brackenridge and van Alderwerelt in turn described it as new, using type material from the same place. The sterile segments are notably ample, for the genus, longer than broad, with rounded apices, and separated by very narrow sinuses.

This is one of the commonest epiphytes of the mossy forest on all Philippine mountains, and I refer to it a very similar Bornean plant.

Polypodium cucullatum var. *planum* Copel., is probably based on immature fronds of mature plants. The segments develop their hygroscopic movement only as the sporangia mature.

CALYMMODON ORDINATUS Copel., sp. nov.

Rhizomate paleis brunneis lanceolatis basibus auriculato-cordatis 1.5 mm longis 0.25 mm latis rarius majoribus inter baseos permultos stipitum vestito; stipitibus caespitosis perdurantibus mox exalatis brevibus; fronde ca. 6 cm longa, deorsum (sterile) 5–7 mm, sursum (fertile) 3–4 mm lata, rhachi gracile rigida anguste alata minute decidue pubescente; segmentis sterilibus anguste oblongis, 3–4 mm longis, vix 1 mm latis, apice rotundatis, herbaceis, firmis, pilis fulvis ca. 0.3 mm longis caducis praeditis, inter se 1 mm (sursum) vel 2 mm (deorsum) distantibus; segmentis fertilibus valde dilatatis, brevibus, acutis, infra sorum modo contractis sed haud pedicellatis, conduplicatis spatio angusto regulariter separatis, explanatis (qua conditione haud naturale) imbricatis; soro lateribus segmentorum latis omnino involuto.

Luzon, Caraballo Mountain, Nueva Vizcaya Province, *Loher s. n.* (1915).

Smaller throughout than *C. gracilis,* and with smaller, less persistent hairs; fertile segments broader but less broadly adnate than in *C. cucullatus;* different from both in firmness of texture and smaller paleæ.

CALYMMODON MNIOIDES Copel., sp. nov. Plate 6.

Caudice elongato gracile, sed ob tegmen profundum ex stipitibus permultis nunquam desinentibus radicibusque confectum columnam validam simulante, paleis ferrugineis obtusis apicibus ciliatis vestito; frondibus multis, tenuiter herbaceis, glabris, ad alam angustissimam costae pinnatifidis, 2–3 cm longis, 5–8 mm latis; segmentis sterilibus oblanceolatis, 1 mm latis, obtusis; fertilibus fere aequilongis, lamina protectrice sori dilatata, costam versus angustatis nullibi lamina carente.

Kaiser Wilhelmsland, in the woods of the Kani Range, altitude 1,000 m. Schlechter No. 17200 (Jan., 1908).

Distributed as *P. clavifer* Hooker, which is a much larger fern, with the fertile segments or pinnæ far more sharply differentiated. In *C. mnioides*, the lower part of these is merely narrowed, and the narrow part is decidedly shorter than the dilated part. In *C. clavifer*, the stalklike portion is approximately as long as the wide part, or even longer, and the contraction goes as far as the complete elimination of the lamina, making this part of the frond truly pinnate.

CALYMMODON CLAVIFER (Hooker) Moore.

Grammitis clavifer HOOKER, 2d Century (1860) 5.
Polypodium clavifer HOOKER, Sp. Fil. 4 (1862) 176.

Caudex rather stout ascending copiously rooting, fronds scarcely stipitate densely crowded caespitose 4–5 inches long firm rigid-membranaceous narrow- or linear-lanceolate acuminate pinnate, pinnae remote patent terminated by 1–3 long setae, *sterile* ones very narrow linear, *fertile* spathulate acute concave the superior margin reflexed, veins solitary simple in each pinna not reaching to the apex soriferous below its extremity occupying the dilated portion of the pinna, rachis very hispid having a narrow wing on each side connecting the pinnae (or the whole frond may be considered deeply pinnatifid).

The original collection was on Mount Kinabalu. It has been found there repeatedly, and once on Mount Apo, in Mindanao, and has been reported from New Guinea.

The stalklike lower part of each "pinna," as long as the dilated portion, and so contracted that any wing on the vein is hardly visible to the naked eye, gives this fern a very remarkable appearance. My reason for mistrusting reports of its occurrence in New Guinea has been given in the discussion of the preceding species.

CALYMMODON CONDUPLICATUM (Brause) Copel., comb. nov.

Polypodium conduplicatum BRAUSE, Engler's Jahrb. 49 (1912) 41, p. 31, fig. 2J.

Eupolypodium. Rhizoma adscendens, pilis fuscis vestitum. Folia numerosa, fasciculata, petiolulata. Petioli validi, teretes, anguste alati- 3–5 mm longi, juventute pilis longis fuscis instructi. Laminae 3–6 cm longae, usque ad 4 mm latae, lineari-lanceolatae, in apicem obtusum desinentes, ad basin versus decrescentes, chartaceae, utrinque pilis longis fuscis armatae, pinnatae; pinnis (lobis) patentibus, interstitiis cr. 1 mm longis disjunctis, integris, alternis, inferioribus sterilibus linearibus vel cuneatis, usque ad 3 mm longis, vix 0.3 mm latis, superioribus fertilibus paulum brevioribus quam steriles, 1.5–2 mm longis, usque ad 1 mm dilatatis, ovoideis, apice acutis, piliferis; rachibus angustissime alatis, pilis longis ornatis; nervis simplicibus. Sori solitarii in lobis, lobis conduplicatis involuti.

Northeast New Guinea, in forests on the Bismarck Range.

Distinguished from *C. clavifer* most essentially by the pubescence, which is so peculiar in *Calymmodon* as to suggest a different descent; also, the development of the "key-like" appearance has not gone nearly so far.

For the use, in this study of *Calymmodon,* of facilities other than those of the University of California and of my own herbarium, I wish to express appreciation of the courtesy of Directors Hill and Diels of the Royal Botanic Gardens at Kew and Dahlem, in placing in my hands material otherwise quite inaccessible, and to Miss Eastwood for similar courtesy on the part of the California Academy of Science.

ILLUSTRATIONS

[Photographs by Matthews.]

PLATE 1. *Calymmodon pergracillimus* van Alderwerelt van **Rosenburgh.** Collected by C. Boden Kloss.
2. *Calymmodon glabrescens* Copeland. Type.
3. *Calymmodon hyalinus* Copeland. Type.
4. *Calymmodon latealatus* Copeland. Type.
5. *Calymmodon hygroscopicus* Copeland. Type.
6. *Calymmodon mnioides* Copeland. Type.

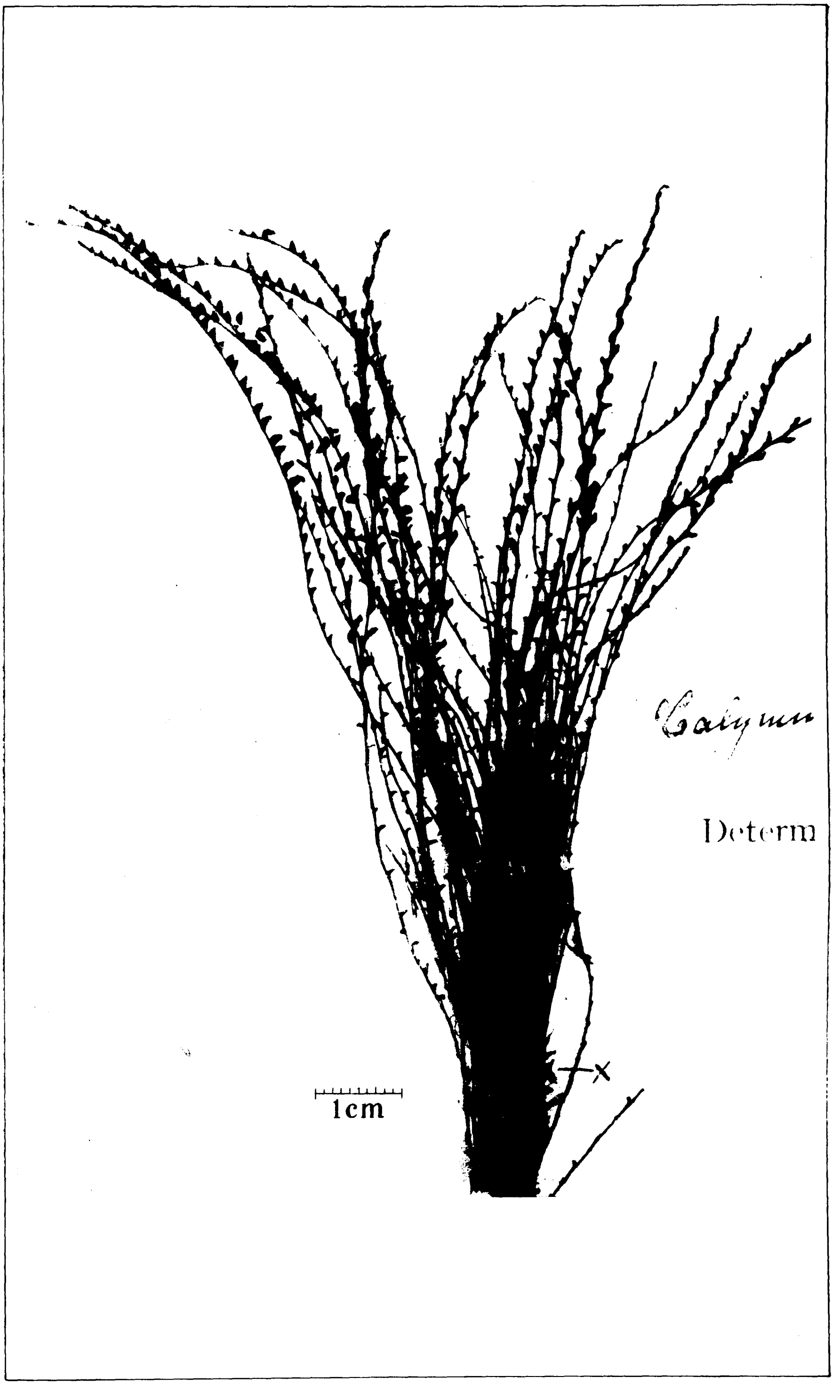

PLATE 1. CALYMMODON PERGRACILLIMUM van ALDERWERELT van ROSENBURGH.

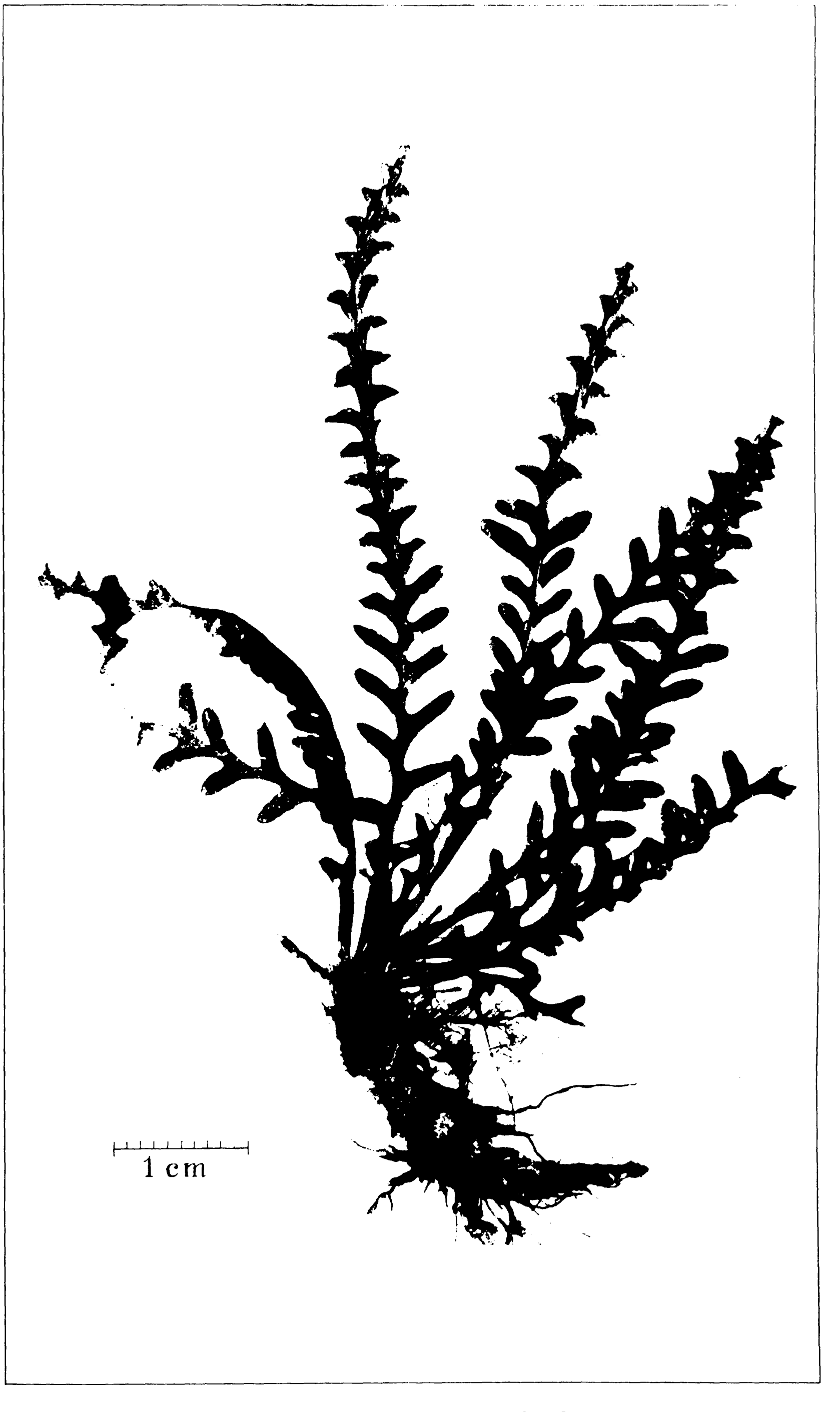

PLATE 2. CALYMMODON GLABRESCENS COPELAND, TYPE.

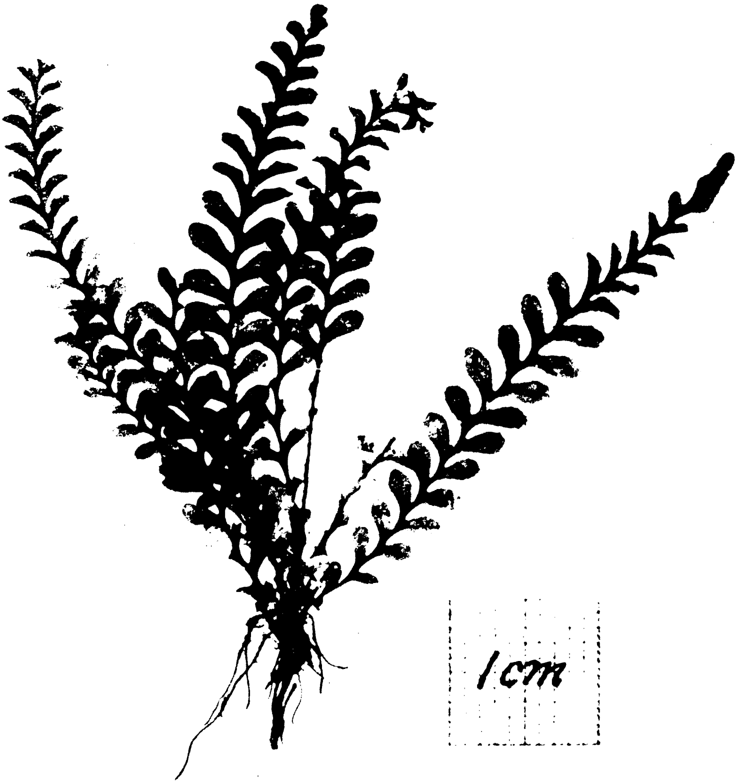

PLATE 3. CALYMMODON HYALINUS COPELAND, TYPE.

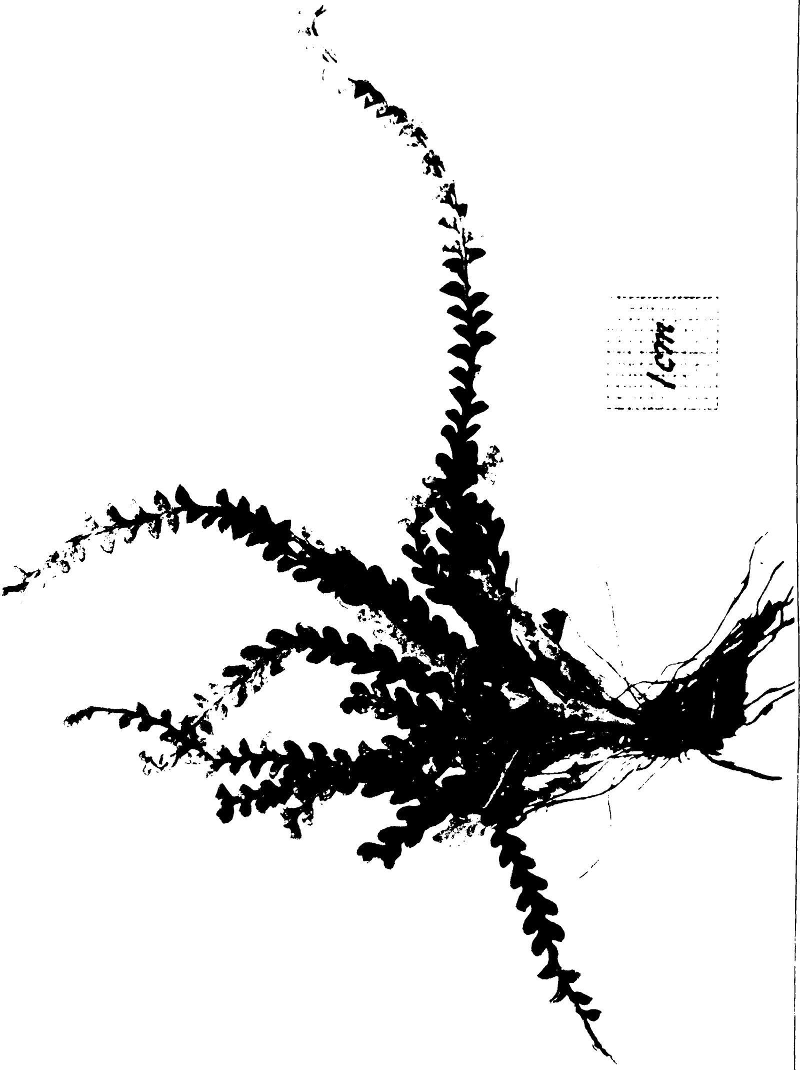

PLATE 4. CALYMMODON LATEALATUS COPELAND, TYPE.

UNIV. OF MICH.

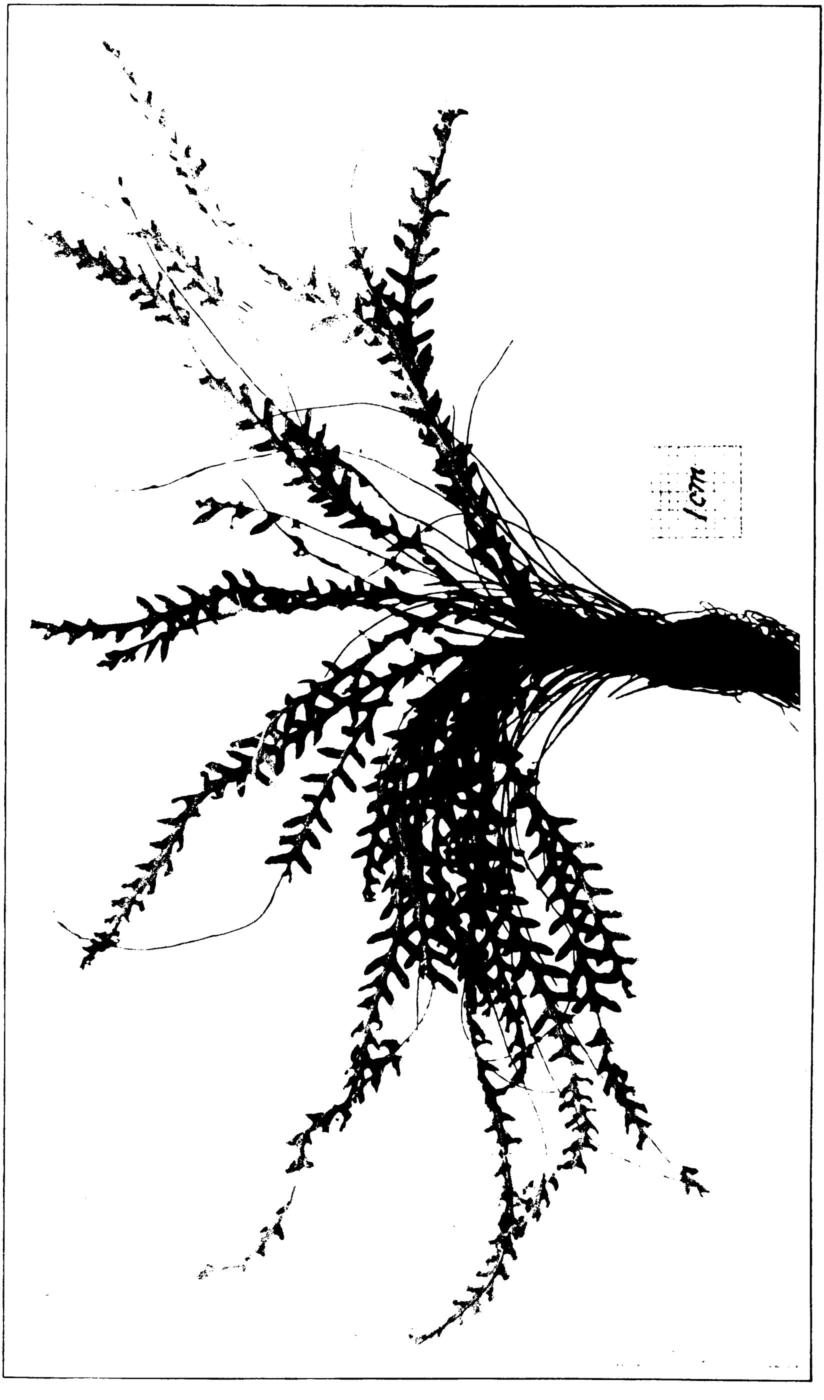

PLATE 5. CALYMMODON HYGROSCOPICUS COPELAND, TYPE.

UNIV. OF MICH.

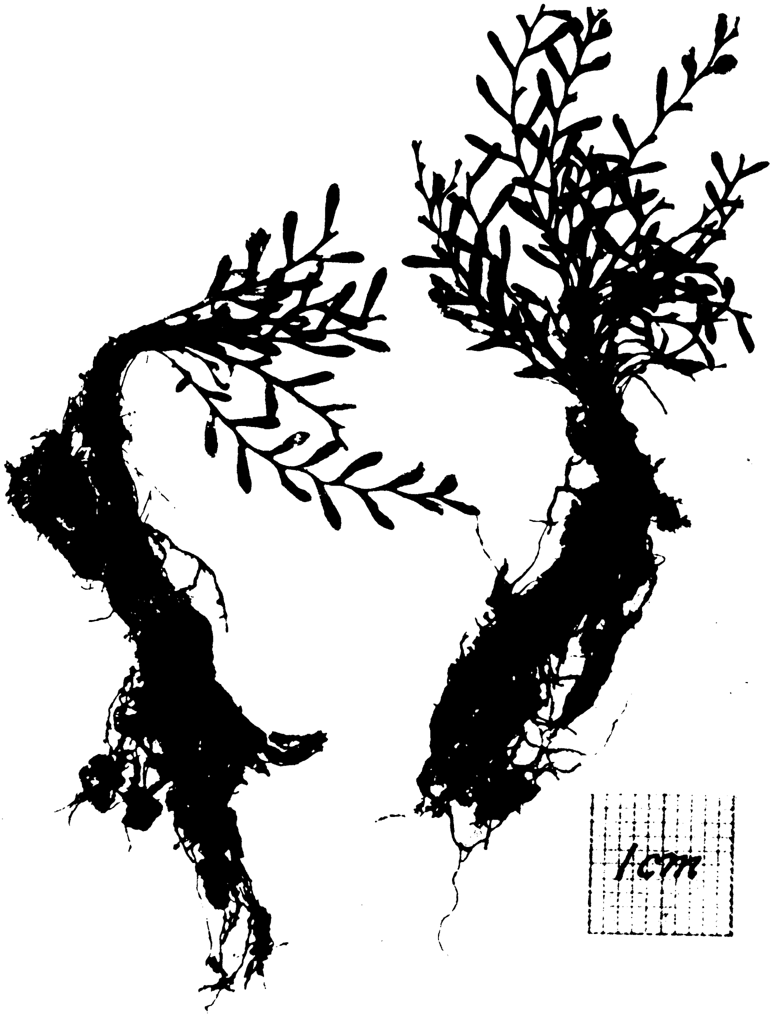

PLATE 6. CALYMMODON MNIOIDES COPELAND, TYPE.

FOUR NEW FISHES FROM LAKE TAAL (BOMBON)[1]

By ALBERT W. HERRE

Chief, Division of Fisheries, Bureau of Science, Manila

THREE PLATES

HARENGULA TAWILIS Herre, sp. nov.

Branchiostegals, 6; dorsal, 17 to 18; anal, 19 to 21; pectoral, 16 or 15; ventral, 8; scales in lateral series, 38 to 40; in transverse series, 11 or 12; gill rakers 50–60+35–37; preventral abdominal scutes, 18; postventral, 12.

The elongate body strongly compressed laterally, ventral profile much more convex than dorsal; covered with hard, closely and firmly attached scales each with 3 vertical lines, the free edge irregularly erose; belly strongly compressed, serrate, each abdominal scute terminating in a sharp spine; depth 3 to 3.5 times, the laterally flattened head 3.5 to 3.9 times in length; orbital space around the circular eye elongated anteriorly, the eye proper 3.22 to 3.66 times in head, the entire orbital space 2.63 to 3 times in head, more than twice as long as the blunt and very slightly emarginate snout, which is 6.6 to 7.25 times in head; the maxillary is very broad posteriorly, covering most of mandible, and extends beneath anterior portion of pupil or beyond a perpendicular from its middle, 2.4 to 2.5 times in head; prominent ridges and striæ above eyes; 5 to 7 or more longitudinal striæ on top of head on each side behind interorbital space; height of operculum three times its width; origin of dorsal nearer to snout than insertion of dorsal is to caudal, or they may be equal; length of dorsal base equal to, or slightly more or less than its height, which is 5.5 to 6 times in its length and about 1.7 times in depth of body; the low anal only 0.3 as high as the dorsal, its base exceeding or equal to that of dorsal; the slender pointed pectoral 1.33 to 1.45 times in head; origin of ventrals below middle or posterior part of dorsal; caudal covered with small scales over most of its length and deeply incised with pointed lobes, 3.7 to 3.9 in length; teeth little evident, rarely present on upper jaw, but usually visible on lower jaw, tongue, palatines, and pterygoids.

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[1] Bombon is the Tagalog name of the lake and the name by which it was known to the Spaniards. Taal is the name of the volcano and city.

Color metallic steel blue with a silvery luster along back, shining silver elsewhere; tips and inner margins of caudal lobes blackish; first dorsal butter yellow with a black spot at origin, and upper half thickly specked with black or a black spot above anteriorly; the other fins colorless, or the pectoral with a fine black line along its upper margin.

Here described from the type, No. 13198, in the Bureau of Science collection, and 77 cotypes, from 78 to 128 millimeters in length, collected at various times and places in Lake Taal. My largest specimens are nearly ripe females.

This sardine breeds in Lake Taal and is not known elsewhere. It has never been taken in the great fish corrals in the outlet of the lake. It is largely caught by drift gill nets, set with the float line a short distance below the surface of the lake. The chief center of the fishery for this sardine is at Talisay, but the sardines are mainly caught around Volcano Island. They are caught at all times throughout the year. Some of my specimens had been feeding on young silversides, *Hepsetia balabacensis* (Seale), which is common in the lake.

Large quantities of this fish are consumed fresh, but they are also dried, though of course they make a very inferior product. In times of plenty they are also cooked with vinegar, wrapped in banana leaves, and shipped to interior points in Batangas Province and to the towns along Laguna de Bay in Laguna Province. Prepared in this way they will keep for three days.

Tawilis is the local Tagalog name.

Genus BOMBONIA Herre, novum

Elongate, slender, head moderate, trunk short, tail very elongate, slender; shields sculptured and corrugated; a prominent keel on belly; anal fin wanting; pectorals and caudal small; dorsal entirely on anterior part of tail; superior cristæ of trunk and tail discontinuous; inferior cristæ of trunk and tail continuous; median cristæ of trunk usually curved downward at posterior extremity and then subcontinuous with inferior cristæ of tail; shields of occiput and nape with a median crest; a median longitudinal keel on operculum.

Eggs small, numerous, carried on the undersurface of the tail of the male, protected by a fold of skin on each side, their free borders very close together or even coalescing.

This genus is sufficiently distinguished from others by the absence of the anal fin.

Known only from Lake Taal, or Bombon, a large fresh-water lake in Batangas Province, Luzon, for which the genus is named.

BOMBONIA LUZONICA Herre, sp. nov.

Dorsal, 23 or 22; anal wanting; pectoral, 14; caudal, 6; rings, 15+37; subdorsal rings, 6.

The angular elongate slender form narrower on dorsal surface than below, trunk heptagonal, the very long tail four-sided; all the plates are finely sculptured with fine ridges; on the belly is a conspicuous knifelike keel, made up of sculptured plates, its height equal to half an eye diameter; greatest depth without keel 17.09 times in length; trunk short, 4.08+ times in length, 2.63 times in the very long tail, which is nearly two-thirds total length, or 1.55+ times in total; head conical posteriorly, 8.95+ times in length, 2.19 times in trunk; the large elongate snout very narrow with concave plates below, enlarged anteriorly, 2.18 times in head; distance from center of eye to tip of snout greater than distance from same point to posterior extremity of head; eye 5.25 times in head, 2.4 times in snout; operculum has a prominent median longitudinal keel, with many fine radiating or transverse ridges below it; a small horizontal spine on middle of anterior rim of eye; a longitudinal crest on each side of top of head, running forward above eyes and on snout for about half its length; a median crest on nape, one on top of head to eyes, and another from anterior part of interorbital space forward on snout for more than half its length; dorsal confined to the first six rings of tail.

Color in alcohol uniform dusky greenish gray, the ventral keel and caudal fin blackish; underside of head whitish.

Here described from the type, a male 94 millimeters long, bearing eggs, and 32 specimens, 43 to 87 millimeters long. Another male, 85 millimeters long, also carried eggs. Only adults have a well-developed ventral keel. Specimens less than 60 millimeters in length are very slender. A few specimens have a few dark spots under the chin or obscure marks on the sides of the head posteriorly.

This unique little fish was obtained in Lake Taal, between Ambulong and Talisay. It lives in the eel grass.

Careful scrutiny with a compound microscope fails to show any trace of an anal fin.

Luzonica, from Luzon.

RHINOGOBIUS FLAVOVENTRIS Herre, sp. nov.

Dorsal, VI–1–10; anal, 1–11; 26 scales in a longitudinal series, 8 in a transverse series.

Body wedge-shaped from above, depth at origin of first dorsal 4.5 to 5.3 times in length; the large head much broader than the trunk, its length 3 to 3.25 times in total length; opercles end in a large thin flap which totally covers pectoral base; the large eyes close together, laterodorsal, largely upward gazing, 4 to 4.3 times in head, interorbital space narrow, smooth, about 4 times in an eye diameter; upper anterior profile gently sloping from origin of dorsal to eyes, the short rounded snout strongly convex, 1.5 times in eye and 6.25 to 6.5 times in head; the oblique mouth very large, jaws curved, posterior angle of maxillary extending to a point beneath center or posterior margin of eye; 4 rows of teeth in front of each jaw, the outer and inner rows enlarged, the two middle rows very small, the innermost row recurved; the teeth in each jaw dwindle to a single row posteriorly; body covered with firm ctenoid scales, head, predorsal region, pectoral base, breast, and median portion of belly naked; first dorsal reaches base of first anal ray when depressed, third dorsal spine usually the longest, although the fourth is often as long and the second rarely equals it, twice or a little more or less than twice in head; second dorsal of nearly uniform height, the last ray usually a little elongate and often reaching caudal when depressed, the last ray scarcely as long as the highest dorsal spine; anal of almost uniform height, 2.5 to 2.6 times in head, its base longer than that of second dorsal; the caudal usually appears pointed but is really bluntly rounded, caudal, pectoral, and ventral of equal length, about 0.7 to 0.75 of head; the broad ventral has a dissected serrate margin and extends to base of second anal ray.

Color in alcohol butter yellow on belly and lower part of sides, dorsal half gray with 5 blackish crossbands on body, alternating with 5 large black spots on middle of side from beneath pectoral to base of caudal; scales on dorsal half more or less margined with blackish; a black spot on top of head behind interorbital, between eye and angle of mouth, and on opercle; entire head with fine black dots; pectorals and caudal heavily crossbarred with black; first dorsal heavily marked with black dots, and with a white spot or spots on upper half behind fourth spine; second dorsal black or black spotted; outer half of anal black, inner half yellow; ventrals uniformly black. The yellow may change to white or gray in alcohol.

Here described from 37 specimens, 25 to 37 millimeters long, collected in Lake Taal, Luzon.

PETROSCIRTES FEROX Herre, sp. nov.

Dorsal, 32 to 36, mostly 33 or 34; anal, 24; pectoral, 12; caudal, 12, not counting the short accessory rays; ventral, 2.

The wedge-shaped elongate body laterally compressed, greatest depth just back of pectoral base, 5.5 to 6 times in length; dorsal profile nearly horizontal, highest at origin of dorsal and descending at a very slight angle in a straight line to caudal base; ventral profile strongly convex below head and belly, then ascending in a moderate straight incline to caudal base; upper anterior profile of head boldly convex; width of head greater than that of body, its length 4.9 to 5.2 times in total length; eye moderate, high up, rarely even with profile, 3.66 to 4 times in head, equal to the steeply curved snout; interorbital width equals half or two-thirds eye; mouth low down, inferior, apparently very small, the lip concealing its posterior angle which is beneath anterior margin of eye; 16 to 18 teeth in upper jaw, 18 in lower jaw; a long stout recurved canine tooth on each side of both jaws, the lower canines much the larger, their length equal to or greater than diameter of pupil of eye; no tentacles or barbels; width of gill opening two-thirds or less than that of pectoral base, at least half its breadth above pectoral base; dorsal and anal extend to, but not upon caudal; dorsal of almost uniform height, equal to or greater than an eye diameter in vertical height, posterior rays elongate and equal to depth, but curved backward so that their vertical height is little or not at all greater than the preceding rays; anal also of almost uniform height, about two-thirds as high as dorsal; origin of anal much nearer tip of snout than caudal, the length of its base 1.5 to 2 times in total length; the pointed pectoral 0.8 to 0.9 length of head; the rounded caudal equals depth; the long threadlike ventral rays may reach anus but usually fall short, 4.66 to 4.9 times in length; equal to or a little longer than head.

Color in alcohol varies from light brown to brownish green or brownish gray, the underparts paler, body crossed by about nine darker vertical bars; often the bars, especially the forward ones, are angled, the point of the angle directed forward; dorsal, anal, and caudal uniform dark brown, or concolorous with body; pectoral pale, ventrals whitish.

Here described from 60 specimens, 31 to 56 millimeters in length, from the vicinity of Ambulong, Talisay, and around Volcano Island, all in Lake Taal. They live amid stones and gravel. When held in the hand they will snap at skin or finger nails and hang suspended by their teeth.

Ferox, ferocious, in allusion to their propensity to seize hold with their fangs.

ILLUSTRATIONS

PLATE 1

Harengula tawilis. (Drawing by A. L. Canlas.)

PLATE 2

FIG. 1. *Bombonia luzonica* Herre sp. nov., adult male, lateral aspect. (Drawing by Jose Nievera.)

2. *Bombonia luzonica* Herre sp. nov., adult male, ventral aspect. (Drawing by Jose Nievera.)

PLATE 3

FIG. 1. *Rhinogobius flavoventris* Herre sp. nov. (Drawing by P. Bravo.)

2. *Petroscirtes ferox* Herre sp. nov. (Drawing by Jose Nievera.)

3. *Petroscirtes ferox* Herre sp. nov., enlarged, to show the teeth. (Drawing by Jose Nievera.)

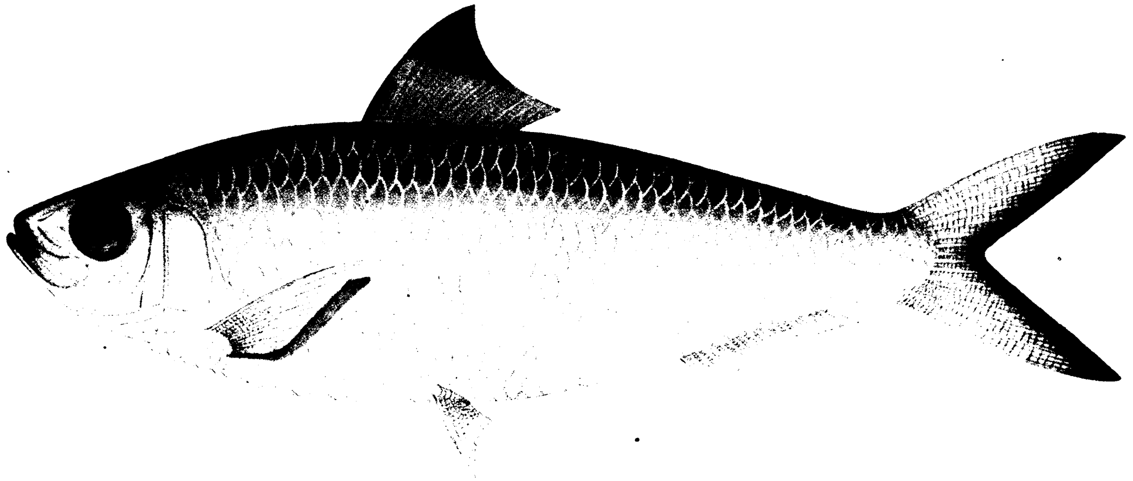

PLATE 1.

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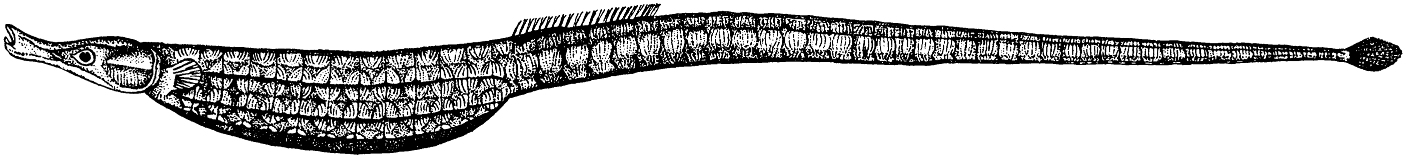

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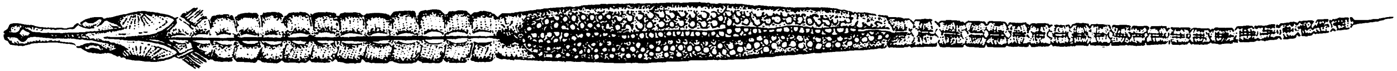

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PLATE 2.

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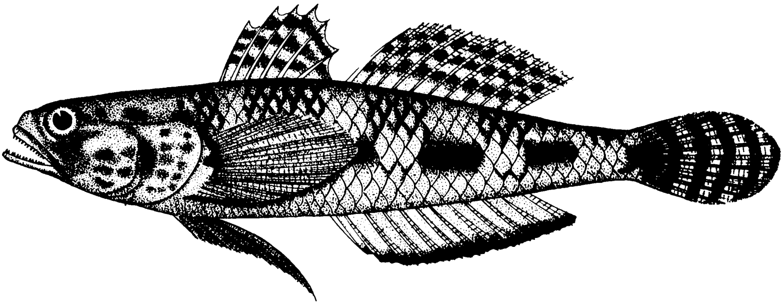

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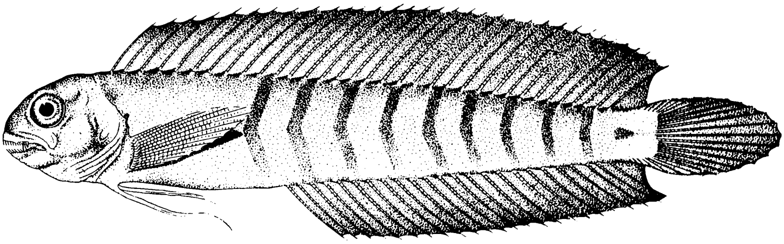

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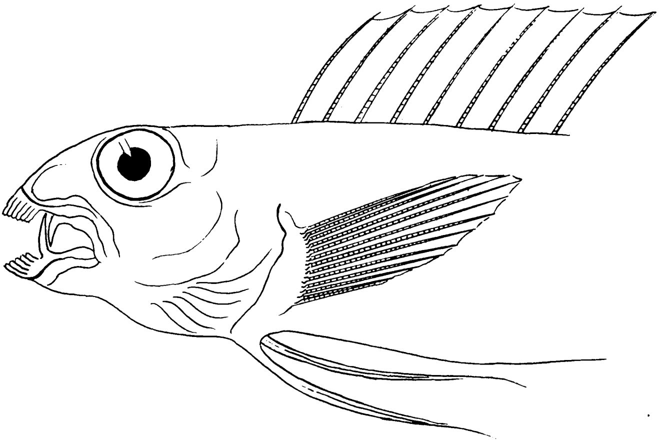

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PLATE 3.

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THE PHILIPPINE BAND FISHES

By ALBERT W. HERRE

Chief, Division of Fisheries, Bureau of Science, Manila

ONE PLATE

CEPOLIDÆ

BANDFISHES

The very elongate, band-shaped body covered with small to minute cycloid scales. Head blunt, with large lateral eyes, a large and very oblique mouth, and projecting chin; teeth of moderate size, in one or two rows, those above on premaxillaries only; none on vomer or palatines. The lateral line ascends from the supraopercular groove to base of dorsal and thence backward, usually obscure.

Dorsal and anal fins very long, composed of slender soft rays, either simple or branched and more or less distinctly articulated; both fins more or less united to the slender, elongate caudal; ventrals thoracic, of one spine and five rays. Bones of skull well ossified, suborbitals not articulated with preopercle; caudal vertebræ exceedingly numerous. Gill openings wide, gill membranes free or scarcely united with isthmus; gills 4; pseudobranchiæ present; branchiostegals 6; air bladder large; pyloric cæca few.

Small fishes of a deep red color, one or two species very handsome, of no economic importance to man. One European, three Japanese, one Indian, and one East Indian species, the last variable in color. At least one Japanese species and the East Indian species occur in the Philippines.

Two genera are known, *Cepola* and *Acanthocepola,* the latter distinguished by having four to eight spines on the lower margin of the preopercle.

Genus ACANTHOCEPOLA Bleeker

Acanthocepola BLEEKER, Versl. Akad. Amsterdam 8 (1874) 369.

In addition to the character of the preopercle, mentioned above, the dorsal rays are simple and indistinctly articulate.

Key to the Philippine species of Acanthocepola.

Dorsal 68–74; anal 72–74; caudal 13; head 6 or 7 in length. **A. abbreviata.**

Dorsal 80–92; anal 78–92; caudal 14; head 8 to 10 in length. **A. krusensterni.**

ACANTHOCEPOLA ABBREVIATA (Cuvier and Valenciennes).

Cepola abbreviata CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 298; CANTOR, Cat. Malayan Fishes, Journ. Royal Asiat. Soc. Bengal 18 (1849) 178; GÜNTHER, Cat. Fishes 3 (1861) 488; DAY, Fishes of India (1878) 324, pl. 68, fig. 4; JORDAN and SEALE, Bull. Bur. Fisheries 26 (1907) 27; WEBER, Fische Siboga Exp. (1913) 266.

Dorsal 68–72; anal 70–74; caudal 13; scales in lateral line about 145; scales in longitudinal series 165 to 175.

The strongly compressed body becomes much narrower and thinner posteriorly and ribbonlike, head about 6.5 times in length and equal to depth; eyes very large, their upper margin almost reaching profile or forming a part of it, 2.66 to 2.7 times in head; snout short, with a central hump, 1.75 times in eye; maxilla very broad posteriorly, its greatest width three-fourths that of eye, its posterior angle beneath pupil of eye; a single row of teeth in each jaw; preopercle has a strong spine at its angle, and three or four more along its lower limb, the number often different on the two sides of the same fish; origin of dorsal above posterior third of opercle, that of anal approximately beneath eighth dorsal ray, both fins continuous with caudal, which approximately equals head; pectoral small, 1.3 to 1.4 times in head; ventral shorter than pectoral, its slender filamentous tip extending beyond origin of anal. The small firm scales distinct, present also on opercles and preopercles.

The color of fresh specimens is a beautiful reddish, merging into brilliant deep red on dorsal, anal, and caudal, paler on head, belly whitish; a series of yellow or orange crossbands on body, becoming broken into elongate spots anteriorly; head and lateral line with a brilliant silver luster over all; anal and caudal with a black marginal line.

Cantor stated that the caudal rays were black and this statement has been copied by subsequent authors, but I do not find them so.

Alcoholic specimens lose their beautiful markings and ground color, but the silvery luster remains.

Here described from three specimens, 175 to 190 millimeters in length, from Manila Bay; the Bureau of Science collection also contains four specimens, 95 to 130 millimeters in length, likewise from Manila Bay. This handsome fish is occasionally seen in the Manila markets.

It was originally described from Java and the Moluccas and is known from Madras, India, eastward through the East Indies and north to China.

ACANTHOCEPOLA KRUSENSTERNI (Schlegel).

Cepola krusensterni SCHLEGEL, Fauna Japonica, Pisces (1845) 130 (not figure); BLEEKER, Act. Soc. Sci. Indo-Neerl. 3 (1859) Japan, pl. 2, fig. 1.

Acanthocepola krusensterni JORDAN and FOWLER, Proc. U. S. Nat. Mus. 26 (1903) 701; SEALE, Fishes of Hongkong, Philip. Journ. Sci. § D 9 (1914) 69.

Dorsal 92; anal 90–92 in my Philippine specimens; others have dorsal 80–84; anal 78–80; Günther gives dorsal 79–89; anal 76–82; caudal 14; scales in lateral line, 160–170; body covered with firm close cycloid scales, very small anteriorly, about 220 in median longitudinal series.

The depth of the very elongate, compressed, ribbonlike body equals the length of the short blunt head, 8.45 to 10 times in length; eye large, its upper margin coequal with profile, 2.9 to 3 times in head, about 1.5 times the blunt snout; the flat interorbital equals or exceeds snout, 4 to 4.6 times in head; teeth stout, of moderate size, in one row in each jaw; my largest specimen has a double row at tip of lower jaw; maxillary extends to or beyond middle of eye, its posterior expanded portion two-thirds an eye diameter in breadth; lower margin of preopercle with four or five strong spines, the one at angle usually largest, the number often different on the two sides of the same fish; opercle and preopercle with many rows of fine scales.

Dorsal and anal low, continuous with caudal; origin of dorsal above upper angle of gill opening, origin of anal beneath ninth or tenth dorsal ray and about opposite tip of pectoral; the pointed pectoral rather small, about two-thirds as long as head; ventral a trifle shorter, its filiform top not reaching anus.

Color in alcohol yellowish, head and belly silvery; traces of the original beautiful red color are visible on the Manila Bay specimen; anal and caudal margined by a narrow black line. In life this species is a bright cherry red.

Here described from two specimens, one 212 millimeters long, from Manila Bay, and one 220 millimeters long, in miserable condition, from Puerto Galera, Mindoro. The Bureau of Science collection also contains Seale's specimens from Hongkong.

This handsome species reaches a length of over half a meter. It is common throughout southern Japan and also occurs on the coast of China.

ILLUSTRATION

PLATE 1. *Acanthocepola abbreviata* (Cuvier and Valenciennes). (Drawing by Jose Nievera.)

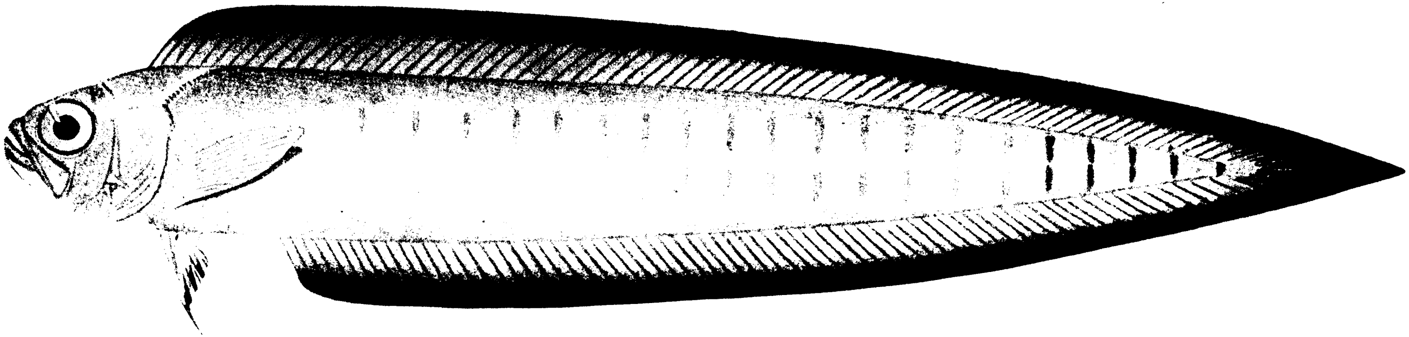

PLATE 1. ACANTHOCEPOLA ABBREVIATA (CUVIER AND VALLENCIENNES).

UNIV. OF MICH.

THE FISHERIES OF LAKE TAAL (BOMBON),[1] LUZON, AND LAKE NAUJAN, MINDORO

By ALBERT W. HERRE

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NINE PLATES

The lakes of the Philippine Islands are of great interest to the geologist and the geographer and often to the seismologist as well. It is the biologist, however, who finds them most fascinating, and it is to the student of fishes and fisheries that they present their most interesting and difficult problems. To some of these lakes belong the most important Philippine fresh-water fisheries. Strange to say, in all the lakes anywhere near sea level, except Laguna de Bay, all of the fishes that give them their commercial importance are marine. There has been no biological survey of any of these lakes, but at various times trips have been made to Lake Taal and Lake Naujan by members of the division of fisheries of the Bureau of Science, and the present paper is the record of the observations then made.

Lake Taal is in Batangas Province, Luzon, and lies about 60 kilometers directly south of Manila. It is of volcanic origin and is in large part a crater lake. The earthquake of 1754 enlarged the lake by causing the land to sink where the town of Taal was previously located.

Lake Taal is a sheet of very beautiful, clear blue water, of moderately irregular outline, and contains several islands. Viewed from the summit of the ridge just north of the lake, which forms the watershed between it and Manila Bay, Lake Taal presents one of the most picturesque and attractive views in the Philippines.

Occupying the center of the picture is Volcano Island, with its huge central pit of Taal Volcano and numerous ancient and long-extinct craters. Scattered about it to the northeast are several islets and the high island of Napayan. It is said that the strange abrupt contour of this island is due to a volcanic eruption which blew out part of the floor of the lake and at the same time carried away half of the island. Filling the landscape in the southeast, beyond Lipa Bay, stands the precipitous bulk of an extinct volcano, Mount Macolod. From a distance it seems to rise vertically from the lake itself, but this is not really the case.

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[1] Bombon is the Tagalog name of the lake and the name by which it was known to the Spaniards. Taal is the name of the volcano and city.

The abrupt descent to the lake is seamed and gashed with enormous tortuous gullies of great depth. The lake seems to be surrounded everywhere, except at the northeast, with similar gullied heights, which show the effects of torrential rains.

Lake Taal is somewhat more than 27 kilometers long north and south, and 20 kilometers wide east and west, with a cercumference of approximately 120 kilometers.

At Ambulong, at the northeast corner of the lake, the gentle slope of the shore is continued into the water for a considerable distance, and the same thing is true at the outlet of the lake and at a number of other spots along its western coast. In many places, however, the shore rises precipitously from very considerable depths. A few meters from land the depth may be more than 100 meters.

Lake Taal has never been surveyed, but a number of soundings have been made at various points. Lipa Bay, including all the portion between its shore and Volcano Island, is deep. For a long distance its depth averages 95 fathoms, with a maximum sounding of 97 fathoms. As a whole, the lake is very deep. Among the large lakes of the Philippines it is only exceeded in depth by Lake Lanao. In 1909 the level of the lake was 2.54 meters above sea level. Whether it was altered or not by the great eruption of Taal Volcano in 1911 is not known. Volcano Island sank at that time, but to what distance was never determined.

Lake Taal is only about 7 kilometers distant from the sea at the closest point. Its outlet, Pansipit River, is a shallow little stream with gentle sinuosities which increase its length to almost 10 kilometers. In former days Chinese junks or sailing ships freely entered Lake Taal (Bombon) and visited Taal and other centers of population on its shores. Later, when the Spaniards came, their caravels likewise went up to the lake.

With the earthquakes of 1749 and, especially, of 1754 all this changed. Taal was practically demolished, the lake covered part of its site, and a new outlet was created. The present source of the Pansipit is perhaps half a kilometer north of the old outlet. The old valley of the Pansipit lies just southward of the little barrio of San Nicolas, which is scattered over the hills the base of which the present course of the Pansipit skirts. This new channel joins the old one a kilometer or two down the river valley. Whether the Pansipit became shallower through the silting of its channel or by changes in the elevation of the land I cannot say, but historical evidence indicates that it is unquestionably not so deep as it was in the sixteenth century.

An examination of the animals of Lake Taal reveals a very interesting fish fauna. In it are several kinds of fishes which do not occur in the sea, but in nearly every case they belong to families the members of which are chiefly marine, or else they have the habit of making annual visits to the sea to spawn. Such are the gobies confined to Lake Taal or to other lakes, and described in my book on the gobies of the Philippines and the China Sea.[2] Broadly speaking, its fish fauna, like that of most of the Philippine rivers and lakes, is marine. Medina, who wrote about the lake in 1629–1630, says that Taal (Bombon) was salt. This is hardly likely though it may have been mildly brackish at that time.

All the large fishes of the lake, and all those that make its fisheries of commercial and political importance, are marine. This fact was noted and practical advantage taken of it by keen-eyed and keener-witted men in the dim forgotten past, hundreds and perhaps thousands of years ago.

It is true that some Malays, such as the Hill Dyaks of Borneo, the Bagobos of Mindanao, and the hill tribes of northern Luzon and Formosa, went to the mountains to live permanently; but it is likewise true that by far the greater number of Malays throughout the lands occupied by them lived along water, either fresh or salt. To this the Malays of the Philippine Archipelago were no exception.

It was only natural, therefore, that the shores of Lake Taal (Bombon) should very early have become the dwelling place of a comparatively numerous population, when by far the greater part of Luzon was uninhabited. The towns of Taal, Lipa, and Tanauan were the natural result of the accessibility of the lake to water transportation and the rich lands along much of its southwestern, southern, and eastern shores.

The great depth of the lake and the ease with which its surface is lashed into waves during either monsoon season made it difficult for those early fishermen to get fish from the lake in their crude dug-out canoes. Even to-day the native boats are unable much of the time to navigate the lake but must wait, often for many days, in the shelter of some safe spot. This is because the longest diameter of the lake is northeast and southwest, and the shores are likewise lowest at those corners. This gives the monsoon of either direction full sweep across the lake.

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[2] Bur. Sci. Monograph 23 (1927).

The men of early times observed in the shallow reaches and on the bars of the Pansipit that fish in vast numbers, and often of great size, went from the lake to the sea. This fact once noticed, the rest was easy. The most efficient means of fishing known to the coast-dwelling Malay, and carried by him in all his wanderings, was the *baklad,* or fish corral.

Fish corrals were therefore placed in the upper Pansipit long ago. It can be safely assumed that the baklad of the distant past were small and transitory affairs, which interfered but little with navigation and were of slight consequence during the rainy season. The population was very small, relatively speaking, and the people had no way of preserving or disposing of large quantities of fish. In fact, there was little necessity for so doing, even had it been possible, since a plentiful supply of fish was available at nearly all times.

More centuries went by. The Spaniards came and after the lapse of many decades Roman Catholicism became established. Under the influence of the padres the people were settled in towns, and Taal was founded in 1572. The population increased at a greater ratio than before, under the more stabilized and peaceful conditions and slightly higher standard of living. In 1716 a frightful volcanic eruption on Volcano Island killed vast quantities of fish in the lake. The waves cast these up on the shores in a cooked condition. The same thing happened again in 1731. The lake was soon repopulated with fish by the natural increase of those remaining in it and the uninterrupted migration of others from the sea. In general, it can be said that there was no diminution of fish in the lake or in its outlet, except temporarily, since there was never complete destruction of the spawning stock.

Time went on and there came the great volcanic eruptions and earthquakes of 1749 and 1754. Population had increased in Batangas; but Taal had been destroyed and reëstablished on the rocky hill beside the left bank of the Pansipit where it debouches into Balayan Bay. In its stead only a few score people were living on the hills about the outlet of the lake. In those days they were practically isolated from the new Taal, 7 kilometers distant by a rude trail over the hills. Lipa, on the eastern shore of the lake, and Tanauan on the northern, had been wrecked, and their discouraged inhabitants removed to the present sites of those towns.

The Pansipit was a shallower stream, at least in part, and it was therefore easier to catch the fish as they took their way to the sea, but the great bulk of the population living about the lake was gone. There was a long period during which but few fish were caught.

During all these centuries there was a vast amount of volcanic activity about the lake, chiefly on Volcano Island. The great central crater, Taal, was a place of intense interest to every intelligent person. For several hundred years it was visited by every traveler or person of note who came to the Philippines, and the records of their impressions and experiences, in Spanish, German, French, and English, are most interesting. Nowhere else could one visit at sea level an obligingly active volcano, guaranteed to give him all the traditional thrills and shocks and usually a few extras not down on the menu.

Slowly the lands about the lake became more densely populated. In time Volcano Island itself, and in fact all tillable land around Lake Taal, became occupied. More than a thousand people were living on Volcano Island when Taal crater blew up in 1911 and destroyed almost the total population.

The pressure of man began to be felt by the fish frequenting the lake. Pansipit River and a goodly portion of Lake Taal (Bombon) belonged to the municipalities of Taal and Lemery. These growing towns, eager for more revenue, always developing more calls for money, put more and more pressure on their fisheries.

Fish, it is self-evident, pay no attention to political boundaries. It should be self-evident that fish, especially the kinds that migrate or move about freely in the water, are the property of the state or the nation. However, in the Philippines, as in Peru and Ecuador, there is a survival of a curious and most pernicious legal custom in certain of the former Spanish colonies. It is perhaps the most ingenious device known to man for ensuring the ultimate complete destruction of the fishery resources of a given region. This evil custom is that of granting to each municipality exclusive control of the fisheries within its boundaries. The natural result is that the municipalities tend more and more to deprive the people of their inherent right to catch fish for home consumption from the waters in front of their dwelling, where their forefathers obtained food for untold centuries. Instead, an exclusive franchise is granted to some individual or group of individuals, the franchise usually, if not always, being granted to the highest competitive bidder.

In some instances a monopolistic franchise, extending over a period of several years, seems to have become more or less of a political plum. Whether this is true or not, in all cases it inevitably tends to acquire an altogether fictitious valuation, which compels the successful bidder to pay entirely too much for his fishing privilege.

This is well exemplified in the fishing license for Pansipit River. The present company holding the franchise paid 134,000 pesos for a five-year license. This sum is divided equally between the municipalities of Lemery and Taal, Pansipit River being the boundary between them. The franchise is monopolistic for the river and also carries with it all fishing rights in that part of the lake contained within the limits of the two municipalities.

At every letting of the franchise during the past few periods the successful bidder has had to make a large advance over the previous contract price. The natural result is that huge permanent baklad have been placed in the Pansipit, and that all fish of edible size are caught, none escaping to the sea. These fish corrals completely block the river, leaving absolutely no open runway for the migrating fish. This is a very serious matter, since it ensures the capture of every fish attempting to return to the sea, leaving none for breeding stock. These baklad are so large and well built that they are not affected by storms or floods. The only way in which their successful operation can be affected is for the river to change its course, or for fish to be able to leap clear over one baklad wall after another.

By digging an artificial runway in which the various pens of the baklad are placed, and by barricading the river with woven bamboo, so that all fish are compelled to enter the baklad, the licensees have averted all difficulties that might ensue were the river to alter its channel. The only fish able to leap over the high walls of the baklad are the meter-long bañgos, which can hurl themselves in the air to an astonishing height. They well deserve their local name of *lumulukso,* the Tagalog word for leaping; but even the agile and athletic lumulukso are rarely able to leap out to safety. The views presented (Plates 3 and 4) show that one pen leads into another, so that when a fish does leap a wall it usually has merely jumped from one inclosure into another.

Naturally the company cannot afford to introduce any conservation methods, since to do so would invite bankruptcy. Before it can earn a profit it must get back the enormous cost of its franchise.

An inevitable result is high prices for fish. When only a moderate amount of fish is being caught the cost at the corral is greater than the price at which the same kind of fish can be purchased in Manila. The company is able to sell most of its catch at very high prices because of the large population in the towns of Lemery and Taal and their numerous barrios, and all along the highway clear to the town of Batangas. The increased truck transportation makes feasible the distribution of fish over a great area, in spite of the fact that as yet most of the catch must be taken to Taal on horseback. When the catch is heavy, fish are taken across the lake to Talisay, loaded on autotrucks, and shipped to Manila. It is easy to see that not only the local increase in population, but also, to a much greater degree, the improvement in transportation bears heavily on the fishes of Lake Taal.

During the late spring and summer months the fry of various marine fishes make their way up the Pansipit and enter Lake Taal. Here they remain for longer or shorter periods of time, depending upon the species. Some kinds stay one, two, three, or more years. One kind of pampano, or *Caranx,* returns at all times to the sea, never remaining until mature, most of the fishes of this genus leaving when about a year old. Bañgos, snappers, and one species of pampano, or *Caranx,* remain until they are fully grown and nearly or completely mature sexually. Then they start for the sea with a rush, since nature is calling them to spawn. Under present conditions none of them ever get there.

People living about the lake complain that the largest and finest-flavored fishes are much rarer now than they were formerly, forty or fifty years ago. It is apparently true that the total number of fish caught at or near the outlet of Lake Taal is as large as ever, and their value is certainly greater than it was formerly. The company holding the franchise is able to catch as many fish as previously by making its baklad larger, tighter, and stronger, so as to catch them all. It is apparently true that there has been a falling off in the catch of the two most valuable kinds, lumulukso and *maliputo.*

The most important of the Lake Taal fishes are various species of Carangidæ, of which *Caranx marginatus* Gill, known as *muslo* locally, is caught in by far the largest quantity. Most muslo leave the lake when they are about a year old, and are not more than half their sexually mature size; many leave much earlier, even when only about 75 millimeters long, and mature muslo are not found in the lake.

Caranx ignobilis (Forskål), known locally as *maliputo,* remains in the lake until it is very much larger, and ready or nearly ready to spawn. It is probably then about three years old. This fish is very highly esteemed, and fetches the highest price.

The fishermen distinguish seven kinds of Carangidæ, but they apply different names to the same fish at various stages of its growth. So far we know definitely of but two species of *Caranx* living in the lake, though it is possible that three may be present.

The fry of bañgos (*Chanos chanos*) remain in the lake until they are at least three or four years old and have reached a length of a meter or more. These large bañgos are called lumulukso, a Tagalog word meaning leaping, because of their astonishing saltatorial powers. Lumulukso are of exceedingly delicious flavor and are comparatively free of the excessively numerous fine bones that are so pestiferous in the young bañgos grown in the fishponds about Manila Bay.

Another valuable fish, which reaches a length of two-thirds of a meter or more and a weight of several kilograms, is the *alsó.* It is a gray snapper belonging to the Lutianidæ, and very close to, if not identical with, *Lutianus argentimaculatus.* One of the red snappers also occurs in the lake, and is occasionally caught with hook and line.

During the height of the rainy season large numbers of *banak, Liza melinopterus* (Cuvier and Valenciennes) and *Liza troscheli* (Bleeker), enter the river on their way to the sea to spawn. It is at this time, too, that most freshwater eels, or *igat, Anguilla mauritiana,* endeavor to return to their remote and mysterious spawning ground. Some of the eels caught are very large. *Kitang, Scatophagus argus* (Gmelin), is another good food fish caught in quantity at times. Hundreds of *buan buan, Megalops cyprinoides* (Broussonet), enter the corral at this time also. Buan buan is a large silvery fish, thin and bony, and of indifferent quality.

In addition to the baklad in Pansipit River, the company operates several other large baklad in the lake itself. These are all located along the southeastern coast, not a great distance from Pansipit River, in water 8 to 12 meters deep, and catch chiefly *malipito* and lumulukso on their way to the outlet of the lake.

Thirteen kinds of gobies are known to occur in Lake Taal. One of them, *biang puti, Glossogobius giurus* (Buchanan Hamilton), is an important food fish to the villagers living about the lake; it is mainly caught by hook and line. Four other kinds of gobies are also large enough or numerous enough to be used commonly as food. They are *Glossogobius celebius* (Cuvier and Valenciennes), *Ophiocara aporos* Bleeker, *Chonophorus melanocephalus* (Bleeker), and *Aparrius acutipinnis* (Cuvier and Valenciennes).

As stated previously, no extended survey has ever been made of the fish living in Lake Taal. Of those thus far known, by far the great majority are migratory. In all other large Philippine lakes *dalag, Ophicephalus striatus* Bloch, is one of the most important fishes, and is caught and marketed in large numbers. *Hito, Clarias batrachus* (Bloch), is also locally important when it occurs in lakes. Although both these fishes occur in Lake Taal, neither of them is of much importance; unquestionably conditions in the lake are not very favorable for them, or they would be more abundant. They swarm in the small streams flowing into the lake, and in the few ponds near it. It is also a singular fact that no catfishes of the family Ariidæ are found in Lake Taal, although they are the commonest fish in Laguna de Bay and occur in large numbers in both fresh and salt water in most parts of the Philippines.

Strange to say, the most important permanent resident of the lake is a sardine, *Harengula tawilis* Herre, which does not occur outside of Lake Taal, so far as known. This thin, hard-scaled, silvery sardine, called *tawilis* by the people about the lake, is not of high quality. It occurs in schools and is caught mainly by gill nets. The fishermen cruise about in their small sailing bancas, or dug-out canoes, until a school is found; then they place their nets and at times make large catches. Frequently they set their gill nets so that these float some distance below the surface, and lift them the next morning. These sardines are mostly eaten fresh or dried; sometimes they are cooked in vinegar, wrapped in banana leaves, and sent to the interior towns of Batangas Province and to the towns along Laguna de Bay. In Morga's Sucesos, written in 1609, he states that the "Indians living on the shores of Bombon preferred this sardine to larger fish. They cooked it in many ways and also dried and cured large quantities."

It is a very interesting fact that sharks are permanent residents in the lake and never attempt to migrate to the sea. This is shown by the fact that they are never caught in the baklad blocking the river. I have been unable to obtain any specimens as yet, and cannot tell whether they breed in the lake or not.

Another resident of the lake of much interest, even though it is not a fish, is one of the banded sea snakes, *Disteira cyanocincta* (Daudin). It is common in Lake Taal, but does not enter any of the other large Philippine fresh-water lakes near sea level.

The following list of species in Lake Taal is by no means complete, but it contains those thus far known to occur there; species positively known to return to the sea to breed are indicated by the letter *M:*

1. *Carcharhinus* sp.
2. *Megalops cyprinoides* (Broussonet); *M.*
3. *Chanos chanos* (Forskål); *M.*
4. *Harengula tawilis* Herre.
5. *Anguilla mauritiana* Bennett; *M.*
6. *Clarias batrachus* (Bloch).
7. *Hemirhamphus quoyi* Cuvier and Valenciennes; *M.*
8. *Zenarchopterus dispar* (Cuvier and Valenciennes).
9. *Hepsettia balabacensis* (Seale); *M.*
10. *Liza melinopterus* (Cuvier and Valenciennes); *M.*
11. *Liza troscheli* (Bleeker); *M.*
12. *Bombonia luzonica* Herre.
13. *Caranx ignobilis* (Forskål); *M.*
14. *Caranx marginatus* Gill; *M.*
15. *Leiognathus caballus* (Cuvier and Valenciennes); *M.*
16. *Amia hyalosoma* Bleeker; *M.*
17. *Mionurus bombonensis* Herre.
18. *Ambassis batjanensis* Bleeker; *M.*
19. *Ambassis urotaenia* Bleeker; *M.*
20. *Priopis buruensis* (Bleeker); *M.*
21. *Priopis gymnocephalus* (Lacépède); *M.*
22. *Kuhlia marginata* (Cuvier and Valenciennes).

23. *Kuhlia rupestris* (Lacépède).
24. *Lutianus argentimaculatus* (Forskål); *M.*
25. *Lutianus* sp.; *M.*
26. *Therapon jarbua* (Forskål); *M.*
27. *Theraponidæ* sp.; *M.*
28. *Gerres punctatus* Cuvier and Valenciennes; *M.*
29. *Sillago sihama* (Forskål); *M.*
30. *Ophicephalus striatus* Bloch.
31. *Pomacentrus tripunctatus* Cuvier and Valenciennes; a ripe female; *M.*
32. *Toxotes jaculatrix* (Pallas); breeds in the lake.
33. *Scatophagus argus* (Gmelin); *M.*
34. *Hypseleotris modestus* (Bleeker).
35. *Ophiocara aporos* Bleeker; *M.*
36. *Gnatholepis volcanus* Herre.
37. *Vaimosa macrognathus* Herre.
38. *Vaimosa piapensis* Herre.
39. *Glossogobius biocellatus* (Cuvier and Valenciennes); *M.*
40. *Glossogobius celebius* (Cuvier and Valenciennes); *M.*
41. *Glossogobius giurus* (Buchanan Hamilton); *M.*
42. *Rhinogobius flavoventris* Herre.
43. *Aparrius acutipinnis* (Cuvier and Valenciennes); *M.*
44. *Chonophorus melanocephalus* (Bleeker); *M.*
45. *Chonophorus ocellaris* (Broussonet); *M.*
46. *Taenioides caeculus* (Bloch and Schneider); *M.*
47. *Petroscirtes ferox* Herre.

There can be no question that the migratory fishes of Lake Taal are being overexploited at the present time. A free runway should be left permanently open in the river, for at least one-fourth of its width. This would give mature fish an opportunity to return to the sea to spawn, thus keeping up the supply of fry to restock the lake. The present method of killing off all breeding stock is slowly but surely destroying the chief food fishes of Lake Taal.

LAKE NAUJAN

Lake Naujan is a large lake in northeastern Mindoro, occupying a portion of the extensive plain lying at the eastern foot of the great central mountain mass of the island. This plain extends from Calapan to Bongabon but is separated from the coast much of the way by high rugged rocky hills.

The lake is not correctly shown on any published map, and apparently has never been surveyed. It is approximately 16 kilometers long by 9 kilometers or more in breadth, of fairly regular outline, with two small islands very close to its eastern bank.

The town of Pola, at the head of Pola Bay east of the central part of Lake Naujan, is only about 5 kilometers away in a straight line. This is the nearest coastal point to the lake, but the intervening range of rugged hills or mountains makes approach from that side difficult. At the northeastern corner of the lake is its outlet, a narrow and very crooked creek about 20 kilometers long, which reaches the sea at the barrio of Lumangbayan. This was the original site of the town of Naujan, which was abandoned about sixty-five years ago because of repeated raids by Moro pirates. The creek is navigable for good-sized launches, although at low tide a bar at its mouth is impassable for anything except small bancas.

To the west Lake Naujan is half encircled by lofty and very rugged mountains, and from its surface one has a most inspiring view of Mount Halcon. The eastern shore of the lake is very bold and rugged, but everywhere else it is bordered by extensive swamps and wide marshes, lake and land passing from one to the other imperceptibly. Beyond the swamps are heavy forests, infested with land leeches. On the mud flats rising a few inches above water are swarms of ducks, white egrets, and sandpipers, while everywhere in the luxuriant lotus and *talahib* growth are rails and grebes. In the lake itself are seen on every hand weird snakebirds.

Crocodiles are very abundant in Lake Naujan, and they evidently find conditions ideal there. The Dominican Navarrete, writing about the year 1650, tells of them snatching people from bancas, and carrying off others when bathing. At the present time they apparently do not attack people. They can be seen at any time on a trip across the lake, and one can usually count from three to half a dozen in sight, their black heads or even their whole form just afloat and looking like floating logs or half-submerged chunks of wood. I have had one between 3 and 4 meters in length come up within 1.5 meters of my boat.

Sharks are more numerous here than in Lake Taal, and specimens 3 or 4 meters in length are caught occasionally by hook and line. *Carcharhinus gangeticus* Müller and Henle, the dreaded man-eating shark of the Hoogly at Calcutta, is the only species known from Lake Naujan.

Tagan, or sawfish, occur in Lake Naujan and are caught at rare intervals at the Butas fish corral. They reach a length of 5 meters.

The fish fauna of Lake Naujan is very similar to that of Lake Taal, but the former lake is far shallower and, as already stated, its borders for long distances are merely swamp. Accordingly there are a few striking differences in the fish faunas of the two lakes. Nowhere does Lake Naujan have any such great depth as occurs in Lake Taal. Over large areas Lake Naujan is only 3 or 4 meters deep, and over still larger areas it is less than 10 or 12 meters deep. It is therefore far richer in plant life, and the water is dense with vegetation for long distances, whereas in Lake Taal the water is generally far too deep for plants to grow from the bottom. Conditions in Lake Naujan are therefore exceedingly favorable for mullet, or *banak*, and consequently for large fishes which prey upon these.

Lake Naujan is deepest in its southern third, where we found depths of 30 to 40 meters a kilometer from the shore.

Lake Naujan has long been noted for its fishes. Navarrete said that the lake was full of fish, especially skates. Sometimes people were able to catch them with their hands; then they would take out the eggs and let the fish go. The eggs when salted were considered a great delicacy and were very much prized when eaten with rice. At the present time skates are apparently unknown from Lake Naujan.

Two fishes of insignificant size and of little value for human food are nevertheless of great importance in maintaining more important fishes. *Pait* is the name applied to a small cyprinid fish which ocurs in great abundance in Lake Naujan and in all the streams tributary to it, as well as throughout northeastern Mindoro. It reaches a length of 75 to 100 millimeters, but, as its name pait indicates, the flesh is bitter and not usually eaten by human beings. This is no drawback to carnivorous fishes and pait forms one of the main articles of diet for the fishes sought by man.

Lan̄garay is the Tagalog name for the species of Ambassidæ, small and very bony, semitransparent, silvery little fishes, which occur in incredible swarms in the rivers at certain times. Lake Naujan teems with lan̄garay and they are apparently the chief food of the singular snakebirds. Lan̄garay are so well armed with dorsal and anal spines that they are safe from small or medium-sized fishes; but large snappers, pampano, dalag, buanbuan, and other large-mouthed carnivorous fishes of 300 or more millimeters in length devour them greedily.

Catfishes of the family Ariidæ seem to be absent from the lake and its outlet, as in Lake Taal and the Pansipit. Conditions would seem to be ideal in Lake Naujan for *kanduli,* so that their absence is puzzling. A still stranger thing, and one which I can hardly believe, is the apparent absence of halfbeaks, family Hemiramphidæ; yet the fishermen assure me there are absolutely none in the lake and its outlet. Halfbeaks are typical of rivers and lakes at low levels in the Philippines, so that their absence from Naujan is one I cannot understand.

At the sitio of Butas, about halfway between the lake and the sea, a baklad has been located for a long time. In former years baklad were erected at other points along the river, but now the municipality grants an exclusive franchise to the highest bidder. He not only secures the privilege of placing a baklad at Butas, but his franchise gives him the fishing rights to the whole river, and for a certain distance into the lake itself.

The Butas baklad is far smaller and cheaper than either of the two operated in Pansipit River, and the methods followed are not so rigorous. Then, too, it is more loosely woven, so that small fish returning to the sea can readily pass through it. The baklad does not occupy the whole river, but extends about three-fourths of the way across. The remaining portion is barred by a dam which does not reach to the surface, but can be crossed by a banca or small launch. Palm leaves are laid across the clear space, and their motion in the current frightens most fish so that they do not attempt a passage. However, snappers and bañgos often leap the slight barrier and thus escape.

The baklad has a wide mouth, facing upstream, of course. This is closed by a net, as shown in Plate 6, fig. 2, whenever the watchers see a sufficient number of fish enter the baklad.

At a shallow place a couple of hundred meters below the baklad the men of the neighborhood have erected bamboo stands, as shown in Plate 7. From these stands they can observe the passing of schools of lañgaray, *Ambassis urotaenia* Bleeker, and they catch these by throwing the *dala,* or casting net. For the privilege of fishing they pay the licensee two-thirds of their catch.

The present holder of the license pays 20,000 pesos for a four-year license. The successful bidder is allowed to pay his license fee quarterly, so that all he need pay down in advance is 1,250 pesos for the first quarter. The baklad costs about 500 pesos, and the total initial expense, including nets and baklad material, does not amount to more than 2,000 pesos. The receipts from the baklad soon repay the first cost and provide a handsome surplus.

The municipal council of Naujan has passed an ordinance requiring the licensee to allow all mullet, or banak, to escape during the period from January 15 to February 15, inclusive. The value of this conservation method is not yet really known, but it is at least a step in the right direction.

The people living around the lake are allowed to fish in it for home consumption only, but there is talk of depriving them of this natural right. Until a few years ago there were no permanent settlements around the lake or along the upper part of the river. Only a few Mangyans lived at times on the shores of Lake Naujan. As late as 1910 there were no more people making their homes beside the lake than in Navarrete's time, two hundred sixty years earlier. Within the past two years over two hundred Ilocano homesteaders have settled on the southwestern shore of the lake, and there are many families now living between Butas and the lake. In a few years more forest and swamp will be cleared, timarao, land leeches, and water fowl will disappear, and autotrucks will be serving a heavy population about the lake and plying between Calapan and Pinamalayan.

The most important fish to the Mangyans and Ilocanos about the lake is dalag. This fish abounds in Lake Naujan and is the principal food fish actually caught in the lake. Most of the dalag are caught with hook and line. First a goby, *Ophiocara aporos* Bleeker, locally known as *palawan,* is caught in a *bobo,* or bamboo trap and is then used for bait. Dalag are caught with pole and line, or more often by attaching long lines, known as "trot-lines" in the Mississippi Valley, to poles erected in the lake. Each long line carries many short lines, a meter or two apart.

The most highly esteemed fish caught in the Butas baklad is *simbad, Caranx marginatus* Gill; this fish, which is the same as the muslo of Lake Taal, returns to the sea at all times of the year and does not remain in fresh water for any fixed period, but the average size of the muslo is greater than that of those of Lake Taal. They usually measure about 250 millimeters in length. Larger ones, distinguished under the name *pinkit,* from

350 millimeters to 0.5 meter in length, are also frequently taken. It is not unusual to take 200 or 300 simbad a day, averaging nearly a kilogram each. The people claim that the simbad taken on their way to salt water, after having lived in Lake Naujan, have a much finer flavor than those taken from the sea.

The largest fish migrating from the lake to the sea are the gray snapper, or alsó, *Lutianus argentimaculatus*. It frequently remains in the lake until mature and then, in the rainy season, starts to the sea to spawn. One or two hundred, averaging 4 to 6 kilograms in weight, may be taken in a single day. Sometimes they are nearly a meter long, and weigh 10 to 12 kilograms. This fish is often caught by hook and line in the lake.

Bañgos, called *bañglis* here, occur as in Lake Taal, running down the river in the spring months, but never in very large numbers. Two or three dozen meter-long fish are a good day's catch, and usually only a few are taken. Owing to their marvelous leaping ability some escape, the Butas baklad being much smaller and lower than those in Pansipit River.

The most abundant fish in the lake, and the one caught in largest quantity at Butas, is a mullet, *Liza troscheli* (Bleeker). Unquestionably several other species of mullet occur in the lake, but I have seen only a few specimens of *Mugil dussumieri*. November to February are the months of the big mullet runs. Their gonads become enormously distended while still in the lake, so that they go with a rush when they finally start to the sea to spawn. In November and December they come down the little river in great schools. Five, ten, even fifteen thousand banak have been caught in a single day in the Butas baklad. The number coming down the river in January and February is very much smaller; but, if the ordinance allowing mullet to pass during those months is well enforced, it will help amazingly in keeping up the run. Large schools of mullet, of various sizes, can be seen in Lake Naujan, but they are seldom taken. Sometimes they are caught with gill nets, but crocodiles and sharks are too apt to play havoc with the net.

Many other kinds of fish are taken at the Butas baklad, but the commercial catch is largely confined to gray snapper, mullet, bañgos, and pampano, or simbad. Other fishes caught in greater or lesser quantity and readily salable are *managat*, or red snapper, *kitang, lumas, damagan, apahap, buan-buan, asohos,* and *bagaoñg*.

The following list of fishes thus far known from the lake is a very incomplete one. It is hoped that during the next year additional specimens may be obtained of the snappers and mullet living in the lake, as well as a representative collection of the small species occurring there. Those known to return to the sea are marked *M* in the list, and the native name is given for most of them.

1. *Carcharhinus gangeticus* Müller and Henle; *M.* Pating.
2. *Pristis microdon* Latham; *M.* Tagan.
3. *Megalops cyprinoides* (Broussonet); *M.* Buan-buan.
4. *Chanos chanos* (Forskål); *M.* Bañglis.
5. *Anguilla mauritiana* Bennett; *M.* Igat.
6. *Barbodes hemictenus* Jordan and Richardson. Pait.
7. *Clarias batrachus* (Bloch). Hito.
8. *Mugil dussumieri* Cuvier and Valenciennes; *M.*
9. *Liza troscheli* (Bleeker); *M.* Banak; when very large, aguas.
10. *Caranx marginatus* Gill; *M.* Simbad when small or medium size; pinkit when large.
11. *Leiognathus caballus* (Cuvier and Valenciennes); *M.* Malaway.
12. *Amia hyalosoma* Bleeker; *M.*
13. *Ambassis batjanensis* Bleeker; *M.* Lañgaray.
14. *Ambassis urotaenia* Bleeker; *M.* Lañgaray.
15. *Kuhlia marginata* (Cuvier and Valenciennes).
16. *Kuhlia rupestris* (Lacépède). Damagan.
17. *Lates calcarifer* (Bloch); *M.* Apahap.
18. *Cromileptes altivelis* (Cuvier and Valenciennes); *M.* Apahap.
19. *Lutianus argentimaculatus* (Forskål); *M.* Alsó.
20. *Lutianus* sp.; *M.* Managat.
21. *Therapon jarbua* Forskål; *M.* To-tot.
22. *Therapon cancellatus* Cuvier and Valenciennes; *M.* Bagaoñg.
23. *Gerres punctatus* (Cuvier and Valenciennes); *M.* Lamas.
24. *Sillago sihama* (Forskål); *M.* Asohos.
25. *Ophicephalus striatus* Bloch. Dalag.
26. *Anabas testudineus* (Bloch). Puyo.
27. *Toxotes jaculatrix* (Pallas). Kataba.
28. *Scatophagus argus* (Gmelin); *M.* Kitang.
29. *Hypseleotris modestus* (Bleeker).
30. *Belobranchus belobrancha* Cuvier and Valenciennes; in Malayas River near the lake.
31. *Vaimosa macrognathus* Herre.
32. *Ophiocara aporos* Bleeker. Palawan.
33. *Glossogobius giurus* (Buchanan Hamilton); *M.* Bia; dapal.
34. *Glossogobius celebius* Cuvier and Valenciennes; *M.*
35. *Chonophorus melanocephalus* (Bleeker); *M.* To-od.
36. *Chonophorus ocellaris* (Broussonet); *M.* To-od.
37. *Taenioides cirratus* (Blyth); *M.*

ILLUSTRATIONS

PLATE 1

FIG. 1. A trading and freight boat on Lake Taal; Volcano Island in the background.
2. Looking up Pansipit River. The weir at the left completely blocks the channel and forces all fish into the baklad.

PLATE 2

FIG. 1. Part of Lake Taal at the source of Pansipit River.
2. Bamboo being prepared for use in the baklad. This is on the wide flat at the source of Pansipit River.
3. Looking up Pansipit River, showing both sides of the river.

PLATE 3

FIG. 1. A bamboo raft, used for catching large bañgos or lumulukso. When they leap to escape they strike the wall, fall on the wide platform, and are then picked up.
2. A view of the main part of the baklad.

PLATE 4

FIG. 1. Inside the baklad, looking downstream toward the runway. Note the bamboo raft at the left; this is the one shown in Plate 3, fig. 1.
2. Small inclosures beside the cottage. Here fish are kept on hand, ready for buyers.
3. Inside the baklad "heart," looking toward the lake; Volcano Island in the distance. The central part is the runway leading into the "heart" of the baklad.

PLATE 5

FIG. 1. Cottage and inner compartment of the Pansipit baklad.
2. A mullet, or banak, caught in the Pansipit baklad on its way to the sea to spawn.

PLATE 6

FIG. 1. A general view of the Butas baklad, Naujan River, Mindoro.
2. Looking upstream from the baklad. The net is used to close the mouth when a school of fish enters.

PLATE 7

FIGS. 1 and 2. Catching lañgaray in Naujan River. The men watch for a school of fish, then throw over it their dala, or casting net.

PLATE 8

FIGS. 1 and 2. Looking downstream at the closed end of the Naujan River baklad.

PLATE 9

FIG. 1. Naujan River baklad. Looking upstream at a small "heart" built at the upper extremity of the side wall of the baklad. The net used for closing the baklad entrance is at the left.

2. An Ilocano homesteader at Malayas, Lake Naujan. The little girls are Mangyans, attending the Malayas farm school.

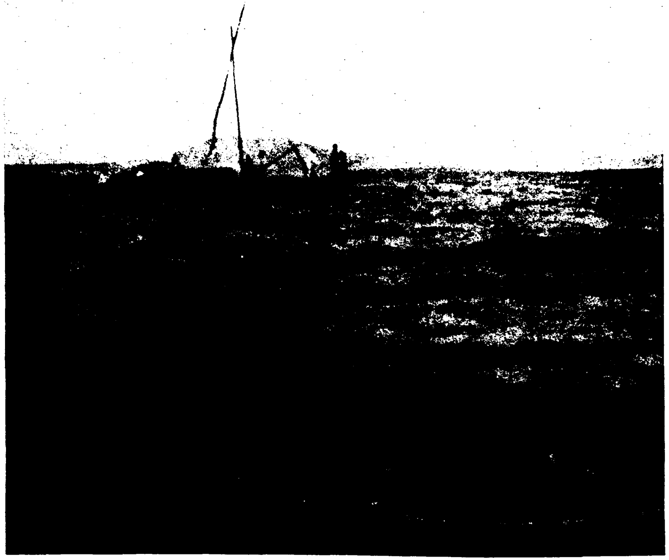

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PLATE 1.

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PLATE 2.

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PLATE 3.

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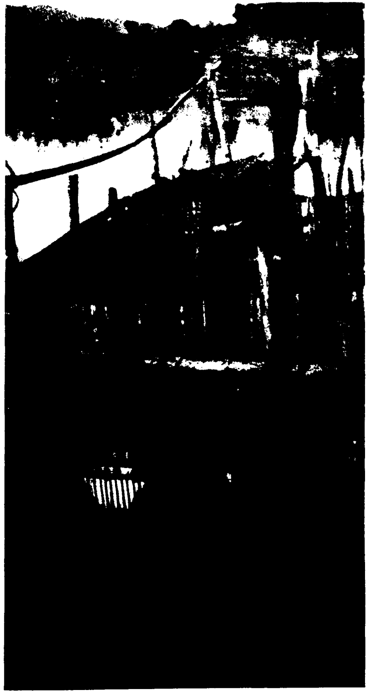

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PLATE 4.

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PLATE 5.

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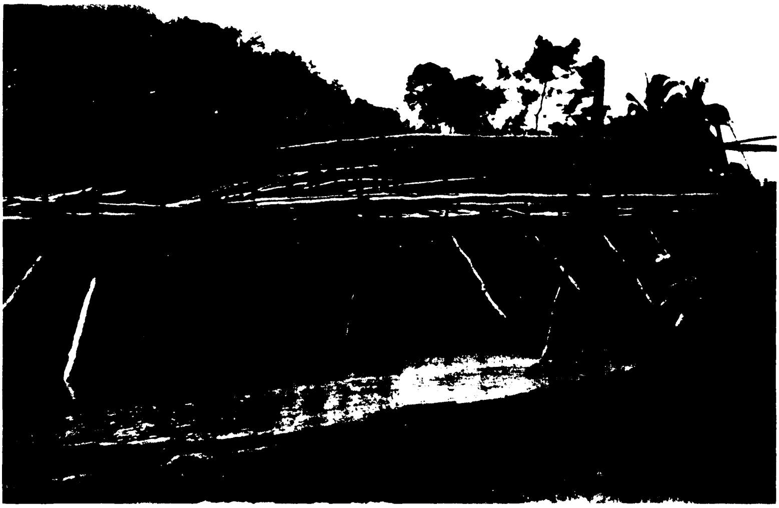

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PLATE 6.

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PLATE 7.

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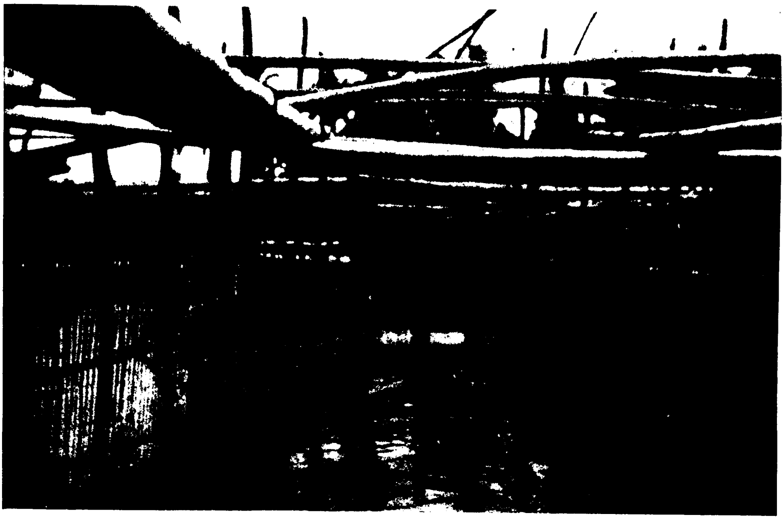

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PLATE 8.

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PLATE 9.

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TINGITIDÆ FROM THE FAR EAST AND MADAGASCAR (HEMIPTERA)

By CARL J. DRAKE

Of the Iowa State College, Ames

Genus ABDASTARTUS Distant

Antennæ very long, slender; segments III and IV very long and slender. Antenniferous tubercles prominent, spinelike. Pronotum and head raised anteriorly, suberect. Legs long and slender. Orifice distinct, prominent. Bucculæ closed in front. Rostral canal open behind. Type of genus, *Abdastartus tyrianus* Distant.

ABDASTARTUS TYRIANUS Distant.

Several specimens: Randoeblatoeng, Java, July 7, 1923, collected on sugar cane; and Formosa. Heretofore recorded by Distant from Bengal and Pusa. The antennæ and legs are shorter in the female than in the male.

ABDASTARTUS MUIRI sp. nov.

Very much smaller than *A. tyrianus* Distant. Head chestnut brown; posterior spines long, stout, blunt, curved, contiguous with dorsal surface of head, directed forward; anterolateral spines short, tuberclelike; median spine wanting. Antenniferous tubercles short, blunt, curved inwardly. Antennæ long, slender, brown; segment I a little longer and slightly stouter than II; IV fusiform; proportional lengths: I = 9, II = 12, III = 62, IV = 22. Bucculæ very broad, closed in front, rostrum reaching metasternum. Coxæ widely separated. Pronotum deeply pitted, transversely swollen through the disk, brown, the carinæ, paranota, and anterior margin pale testaceous. Paranota narrow, uniseriate, collum very distinct, broad, the anterior row of cells pale testaceous. Carinæ prominent, each composed of a single row of minute cells, the lateral carinæ slightly divaricating in front.

Elytra brownish testaceous, areolæ evenly arranged, the areas bounded by prominent nervures; costal area narrow, uniseriate, testaceous, the cells translucent; subcostal area biseriate; discoidal area impressed, reaching slightly beyond middle of elytra, with four rows of cells at its widest part. Wings considerably longer than abdomen, but shorter than elytra. Body beneath dark reddish brown. Metasternal orifice prominent. Legs long, slender, brown. Length, 2.14 millimeters; width, 0.5.

Holotype (male) and allotype (female), Pekalongan, Java, May, 1907, F. Muir, collector, in Drake collection. Paratype (male), Singapore, India, in Baker collection. The much smaller size and concolorous costal area readily separate this species from *A. tyrianus* Distant.

TRACHYPEPLUS BAKERI sp. nov.

Ovate, brownish testaceous, marked with dark brown to fuscous; head and pronotum chestnut brown, with the prominent white exudations. Bucculæ broad, reticulate, closed in front. Rostral channel widening posteriorly; rostrum reaching to intermediate coxæ. Eyes blackish. Antennæ moderately long; segment I a little stouter and slightly longer than II; II obconical, brown; III testaceous, very slender, a little more than twice the length of IV; IV brown, much longer than I and II taken together, fusiform, considerably stouter than III, clothed with moderately long hairs. Head short, with five spines; each spine stout, moderately long, blunt, semierect, testaceous, embrowned at tip. Antenniferous tubercles spinelike, testaceous, bent obliquely downward and contiguous with head. Pronotum moderately narrowed anteriorly, broad in front, strongly and transversely swollen through the disk, coarsely punctate, clothed with numerous, short, scalelike hairs, tricarinate. Paranota reflexed back against pronotum, with three to four rows of areolæ, armed with a few sharp spines along the sides. Carinæ distinct, parallel, nonreticulate. Median portion of pronotum strongly raised anteriorly, forming a rooflike hood, projecting triangularly in front.

Elytra broadly rounded behind, the lateral margins armed with sharp slender spines, sparsely clothed with short yellowish scalelike hairs, testaceous; a broad transverse band near apex, a broad fascia at middle of costal area, most of the nervures of sutural area and a rather broad and somewhat circular ringlike area near the middle of each elytron brown to fuscous; areolæ translucent. Costal area mostly quadriseriate, the areolæ not arranged in very regular rows; subcostal area mostly biseriate, triseriate at the widest part; discoidal area broad, with eight rows of cells at the middle, narrowed at the base and apex. Length, 2.5 millimeters; width, 1.41.

Holotype (male), Iligan, Mindanao, Philippine Islands, collected by C. F. Baker, in Drake collection. Allotype (female), taken with holotype, in Baker collection. This species may be distinguished from *T. jacobsoni* Horvath by the broad costal area.

ELASMOGNATHUS HELFNERI Fieber.

One specimen, female, Mount Maquiling, Luzon, Philippine Islands, C. F. Baker, collector. The bucculæ are closed in front and the metasternal orifice is distinct.

ELASMOGNATHUS INUSITATUS sp. nov.

Elongate, widening posteriorly. General color black; hood brownish; costal area brownish testaceous, the prominent transverse nervures and a broad band near the middle black; areolæ along distal margin of elytra brownish testaceous. Legs brown, the tarsi and apices of tibiæ black.

In form and general color very similar to *E. greeni* Kirby, but larger and longer; antennæ and legs also longer. Antennæ brown, the distal segments black; segment I brown, thicker and nearly twice as long as II; III very long, slightly curved, more than two and a half times as long as IV; IV slightly enlarged, clothed with numerous short hairs, brown at base. Paranota formed somewhat as in *E. nepalensis*, but larger at base and more distinctly constricted below the knob. Hood larger and higher than in *greeni*, somewhat cone-shaped. Median and lateral carinæ a little larger than in *greeni*. Apex of pronotum black. Elytra a little broader and longer than in *greeni;* costal area slightly broader and the transverse band a little narrower; subcostal area broader, biseriate, the areolæ larger. Hood and spines as in *greeni*. Bucculæ closed in front. Rostral channel gradually widening posteriorly, open behind, the rostrum reaching between intermediate legs. Wings a little shorter than abdomen. Body beneath black. Length, 6.5 millimeters; width, 2.1.

Holotype, male, Mount Maquiling, Luzon, Philippine Islands, collected by C. F. Baker; in Drake collection.

HARMIDAS DIVERSATIS sp. nov.

Moderately large, elongate, testaceous, with brown or black markings. Pronotum, head, and body beneath clothed with white recurved hair. Legs moderately long, slender, pale testaceous.

Rostrum reaching almost to intermediate coxæ. Bucculæ closed in front. Head brown, with five long slender spines, the posterior pair a little longer than the others. Antenniferous tubercles spinelike, not quite reaching tip of first antennal segment. First and second segments of antennæ moderately stout, brown, the third and fourth segments wanting.

Nervures of paranota, carinæ, and elytra clothed with numerous, moderately long, yellowish hairs, the tips of which are slightly recurved. Paranota narrow, uniseriate, composed of five moderately large cells. Pronotum slightly swollen through disk; carinæ foliaceous, each composed of a single row of moderately large cells. Collum and median carina jointly raised in front. Areolæ of elytra, carinæ, and paranota whitish, opaque, costal area uniseriate; subcostal area mostly uniseriate; discoidal area impressed, long, narrow, triseriate at the widest part. Length, 2.16 millimeters; width, 0.91.

Holotype (female), Madagascar, in Drake collection. Differs from *H. vicarius* Drake and *H. pictus* Distant in having the paranota and costal area uniseriate. The outer nervure of paranota does not terminate in a spine anteriorly. The apex of discoidal area and the nervure between subcostal and discoidal areas are raised as in *H. pictus* Distant.

XENOTINGIS TREPIDANTIS sp. nov.

Elongate, slightly widening posteriorly. Head brown; spines brownish testaceous, moderately long, stout, blunt, directed downward. Antennæ long, moderately slender, brown; segment I a little stouter and longer than II; III very long, slenderest, slightly curved, twice as long as I and II taken together. Bucculæ broad, closed in front. Rostral channel wide; laminæ broad; rostrum reaching to the middle of the first abdominal segment. Antenniferous tubercles broad, laminalike, broadly rounded in front, prominent. Odiferous canal very long, prominent. Legs moderately long, brown.

Paranota extremely large, semiglobose, projecting over the pronotum, the areolæ large. Pronotum brown, long, tricarinate, with median and triangular portions exposed. Hood covering base of head, somewhat cone-shaped, the median carina strongly raised anteriorly, uniting with the crest of the hood. Lateral carinæ foliaceous, areolate, constricted near the middle, exposed behind; the paranota projecting above and covering the greater portion of them. Elytra slightly widening posteriorly, rounded behind, brown, with testaceous markings; costal area broad, the outer margin recurved (rolled) on the basal half, triseriate at the base, apical half biseriate and testaceous; subcostal area mostly triseriate; discoidal area very distinct, extending a little beyond the middle of the elytra, widest at middle, with five rows of cells at widest part. Areolæ on distal half of elytra somewhat clouded with fuscous. Areolæ of paranota large, not transparent; wings longer than abdomen, but much shorter than elytra. Length, 4.42 millimeters; width, 2.1.

Holotype (female) Madagascar, in Drake collection. Paratype (female), taken with type. The stronger antennæ and legs, shape of paranota, and distinctly larger nervures separate this species from its congeners. The margins of the paranota leave a long rectangular space (median portion) of the pronotum exposed between them. The areolæ of sutural, discoidal, and basal half of costal areas are opaque.

SERENTHIA VICINALIS sp. nov.

Elongate, narrow, pale testaceous, the head and pronotum (collum and triangular process testaceous) dark reddish fuscous to black. Antennæ and legs brownish testaceous. Legs short. Antennæ moderately long, rather stout; segment I slightly thicker and subequal in length to II; III not very slender, three times the length of II; IV nearly one and a half times the length of II, fusiform, clothed with a few long hairs. Antenniferous tubercles prominent, blunt, brownish. Bucculæ broad, closed in front; rostrum short, not quite reaching to the mesosternum. Rostral channel very shallow; posterior margin of pronosternum roundly excavated. Head with four rows of large pits, two along the median line and one on each side a little above the eye.

Pronotum faintly raised on the disk, shiny, coarsely pitted, unicarinate; humeri not prominent; calli brownish black; collum distinct; median carina present, but not prominent. Elytra evenly reticulated, long; costal area uniseriate, the areolæ moderately large; subcostal area triseriate, the areolæ very small; discoidal and sutural areas not differentiated. Areolæ hyaline. Length, 2.5 millimeters; width, 0.54.

Holotype (male) and allotype (female), Mount Maquiling, Luzon, Philippine Islands, Drake collection. Paratypes (male and female), Imugan, Nueva Vizcaya Province, and Mount Maquiling, in Baker collection. The third segment of the antennæ is longer in the male than in the female (male = 37, female = 30). The form and color readily separate this species from *S. formosana* Matsumura.

SERENTHIA SEDALIS sp. nov.

Head and eyes black. Antenniferous tubercles short and blunt. Antennæ moderately long, brown, the third segment and sometimes the fourth dark brownish fuscous; segment I stouter and longer than II; III gradually becoming smaller toward apex, twice as long as IV, the latter clothed with longer hairs and distinctly longer than I. Rostrum stout, reaching to mesosternum.

Pronotum coarsely pitted, shiny, considerably swollen through the disk, unicarinate, the carina not prominent on the disk, black; marginal row of areolæ of collum and triangular process testaceous or brownish testaceous. Legs brown, moderately stout. Elytra rounded behind, testaceous or brownish testaceous; costal area composed of one row of moderately large areolæ; subcostal area very broad, quadriseriate; discoidal area distinct, narrowed at base and apex, with four to five rows of areolæ at widest part. Areolæ mostly hyaline. Length, 2 millimeters; width, 0.52.

Six specimens, Manila, Philippine Islands, Robert Brown collection. Holotype (male) and allotype (female) in United States National Museum. Paratypes in Drake collection and National Museum.

NEW SPECIES OF PYRAUSTINÆ FROM THE PHILIPPINE ISLANDS

By W. SCHAUS

Of the United States National Museum

THREE PLATES

Specimens of the following species, with the exception of two, were presented to the United States National Museum by Prof. C. F. Baker, of the College of Agriculture, Los Baños.

PILOCROCIS POLIALIS sp. nov. Plate 1, fig. 12.

Female.—Palpi hair brown, underneath pinkish buff. Body above pinkish buff; front of collar and shoulders fuscous black; body below white, the legs pinkish buff; a dark band on fore tibiæ. Wings pinkish buff, silky, suffused with light brownish drab, the lines very fine, fuscous; a terminal line; cilia silvery white or drab according to light. Fore wing: costa fuscous to postmedial line; an outbent antemedial line; a small spot in front of cell; a line on discocellular; postmedial line dentate with points on veins, almost vertical to vein 3, obsolescent and well inset, with outbent line from vein 2 to inner margin. Hind wing: a point on discocellular; postmedial line slightly outcurved, punctiform to vein 3, deeply inset, and sinuous from vein 2 to inner margin near anal angle. Wings below similar but paler.

Expanse, 35 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33215, United States National Museum.

PHOSTRIA HILLALIS sp. nov. Plate 2, fig. 2.

Female.—Head, collar, thorax, throat, fore femora and anal segment of abdomen primuline yellow; two black spots on thorax meeting in front; a black stripe from shoulder on tegulæ; two vertical black lines on mesothorax and a transverse bar on metathorax; abdomen black, the two basal segments yellowish overlaid with black hairs; legs black. Fore wing black; a primuline yellow spot at base of costa and cell, followed by a thick white line from subcostal, downbent and excurved to middle of submedian vein, above it a large round antemedial white spot from within cell to below submedian; a small white spot at middle of cell, and a large round white spot over discocellular area, this spot larger than the antemedial spot; all the veins from cell, and outer half of submedian grayish white. Hind wing black; a broad white fascia from middle of costa abruptly upbent to base of inner margin and expanding to near anal angle, its outer edge sinuous at bend. Fore wing below black; a smaller antemedial spot; only a trace of spot in cell, the outer spot as large as above. Hind wing below as above.

Expanse, 37 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33216, United States National Museum.

Named in honor of Mrs. Gillett Hill, who contributed to the purchase of the Dognin Collection.

PHOSTRIA PRIMULOSALIS sp. nov. Plate 2, fig. 1.

Male.—Body above and wings light brownish olive, sometimes slightly darker. Body below hair brown, the long hairs on legs partly tilleul buff. Fore wing: antemedial, postmedial line and a line on discocellular blackish brown, rather thick, the antemedial outbent from costa, the postmedial slightly outcurved to vein 2 and inbent to inner margin, somewhat macular. Hind wing: very faint traces of a medial line; base of costa whitish. Wings below hair brown, with faint traces of postmedial line; inner margin of fore wing whitish.

Expanse, 34 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33217, United States National Museum.

Described from 4 males. The legs are fringed with hair as in *P. origoalis* Walker; the fore wing is broader, the apex less acute, the termen straighter, and the abdomen below is not white as in that species.

PHOSTRIA AENGUSALIS sp. nov. Plate 2, fig. 4.

Male.—Palpi, head, collar, and shoulders maize yellow. Thorax yellowish crossed by black lines, the anterior line also crossing the tegulæ. Abdomen above black dorsally mottled with yellow scales; anal hairs yellow tipped with black; body below yellow with black ventral spots. Wings maize yellow. Fore wing: costal margin black; termen black expanding on inner margin, narrow between veins 5 and 6, preceded by an elongated black spot; a subbasal black mark, narrow at costa, expanding on inner margin; antemedial line outbent, curved along inner margin and upbent to costa beyond cell; a fine curved black line on discocellular posteriorly touching the upbent line. Hind wing: a medial thick black line; termen black expanding between veins 5 and 6, and below vein 2. Underside of wings the same, but without basal and antemedial line on fore wing.

Expanse, 18 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33218, United States National Museum.

Closely allied to *P. mimastis* Meyr.

PHOSTRIA CELSUSALIS sp. nov. Plate 1, fig. 3.

Female.—Body and wings maize yellow, the markings black; a transverse spot medially on collar behind; a small spot on shoulders; a large white spot on metathorax edged with black; dorsal and subdorsal spots on third segment of abdomen, the following three segments with smaller dorsal and lateral spots; anal hairs tipped with black. Fore wing: a subbasal spot on inner margin; a broad antemedial fascia, somewhat diffuse like conjoined streaks; a spot in cell and line on discocellular; a broad outer fascia projecting basad between veins 5 and 6, consisting of broad connected streaks, outwardly in part connected with cuneate spots to vein 2, then inset forming a large spot not touching inner margin. Hind wing: a spot in cell; a broad postmedial fascia of conjoined oval spots, those below vein 6 and vein 2 prolonged basad, also a point above vein 6; subterminal small spots below veins 8 to 6. Wings below very similar, the termen on fore wing from costa to vein 2 suffused with fuscous.

Expanse, 21 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33219, United States National Museum.

Belongs to same group as *P. aengusalis* sp. nov.

PHOSTRIA DRUONALIS sp. nov. Plate 2, fig. 6.

Male.—Palpi light buff; head white; collar and anterior half of tegulæ antimony yellow. Abdomen above fuscous black; lateral tufts wood brown, anal tufts light yellowish buff, abdomen below creamy white. Fore wing silky snuff brown with a purplish suffusion; costal margin antimony yellow; termen and apex golden light orange yellow; faint traces of a black postmedial line, outcurved beyond cell on edge of dark portion of wing; a faint black spot on discocellular; cilia silvery white.

Hind wing entirely silky fuscous, with faint traces of postmedial line; cilia tipped with white. Wings below pale orange yellow with a broad postmedial fuscous line preceded by purplish suffusions, more pronounced on fore wing.

Expanse, 17 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33220, United States National Museum.

Also belongs to the group of *P. aengusalis* sp. nov.

LAMPROSEMA ALICIALIS sp. nov. Plate 2, fig. 5.

Male.—Body and wings above silky olive brown suffused with purplish; palpi and body underneath white; legs white, fore femora and tibiæ olive brown; mid and hind tibiæ partly streaked with brown; anal hairs white. Wings: lines fine, blackish; a fairly large white spot at discocellulars inwardly edged with black; cilia tipped with white. Fore wing: antemedial line faintly outcurved; postmedial line almost vertical, faintly dentate, retracted at vein 2 and downbent. Hind wing: postmedial line as on fore wing, more distinctly dentate between veins 5 and 2. Fore wing below light drab, the discal spot smaller, the postmedial line as above; hind wing below paler than fore wing; a black line on discocellular, the white spot very faint; postmedial line as above. Palpi and legs normal.

Expanse, 24 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33221, United States National Museum.

A series collected by Prof. C. F. Baker.

In apearance very much like *Phostria discipunctalis* Hampson.

LAMPROSEMA BONITALIS sp. nov. Plate 2, fig. 8.

Male.—Body and wings above grayish hair brown, abdomen with fine segmental white lines. Body below white; legs ecru-drab, fore tibiæ darker. Fore wing: lines fine, black, the antemedial slightly outcurved, the postmedial faintly curved from costa to below vein 3, retracted to lower angle of cell, and slightly outcurved to inner margin; a bar on discocellular; a black terminal line; a pale line at base of cilia followed by a broader black line, the tips like wing. Hind wing: postmedial line retracted to cell at vein 2; terminal line as on fore wing; outer half of cilia pure white. Wings below pale ecru-drab, the postmedial line hardly visible.

Expanse, 21 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33222, United States National Museum.

A series in the National Museum.

DICHOCROCIS DORSIPUNCTALIS sp. nov. Plate 1, fig. 5.

Male.—Head and body cream white; second joint of palpi laterally fuscous; a narrow fuscous line on front of collar and shoulders; subdorsal black spots on abdomen, and a dorsal spot on anal segment; abdomen below with segmental drab lines. Wings cream buff, the lines fine benzo brown, on costa of fore wing thicker and black; a terminal line, thicker on hind wing. Fore wing: a subbasal spot on costa; antemedial line straight, faintly outbent; a line on discocellular; postmedial broad on costa, vertical, incurved, lunular from vein 8 to vein 5, then well outcurved and punctiform to vein 2, inset and inbent from vein 2 to inner margin. Hind wing: a line on discocellular; outer line bluntly outbent between veins 5 and 2; cilia of both wings crossed by a dark line and tipped with white. Wings below similar, paler.

Expanse, 23 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33223, United States National Museum.

DICHOCROCIS GALMERALIS sp. nov. Plate 1, fig. 4.

Male.—Palpi white; a curved drab line on second joint. Frons white with a central drab line; vertex and collar cinnamon drab; thorax and abdomen white with some drab shadings. Legs white; fore legs with benzo brown bands. Wings white; a terminal benzo brown line; cilia white divided by some dark scaling. Fore wing: lines benzo brown; a subbasal line followed by a broad light cinnamon drab fascia; antemedial line at one third from base, vertical; medial space irrorated with light cinnamon drab, especially on veins beyond cell; a bar on discocellular; postmedial line inbent from costa near apex, slightly sinuous to vein 2, shortly inturned along vein 2 and wavily inbent to middle of inner margin; a subterminal cinnamon drab fascia expanding to inner margin. Hind wing: antemedial line broader on discocellular, benzo brown, narrower toward inner margin above anal angle, preceded along inner margin toward base by light cinnamon drab shading; medial space as on fore wing; postmedial line and subterminal fascia suffusing below vein 2 to anal angle. Wings below whitish; small spots on discocellulars; subterminal line fine; traces of subterminal dark shading.

Expanse, 17 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33224, United States National Museum.

SYLEPTA CATHANALIS sp. nov. Plate 3, fig. 9.

Male.—Head and body light orange yellow; fore femora orange buff; fore tibiæ cinnamon buff with a broad black band. Wings iridescent purple drab; fore wing light orange yellow at base; hind wing with maize yellow fringe on inner margin.

Expanse, 37 millimeters.

Habitat.—Surigao, Mindanao; Mount Maquiling, Luzon.

Type.—Catalogue No. 33225, United States National Museum.

SYLEPTA BANOSALIS sp. nov. Plate 2, fig. 3.

Male.—Body and wings avellaneous suffused with olive buff. Palpi below and throat white; abdomen underneath white. Fore wing: a faint darker antemedial line below cell; a point in cell, and larger spot on discocellular; postmedial line remote, obliquely curved, and inbent below vein 3, with fine dark streaks on veins, slightly outangled with a larger point below vein 2. Hind wing with a faint medial line, upturned below vein 3, not reaching inner margin.

Expanse, 40 millimeters.

Habitat.—Los Baños; Surigao.

Type.—Catalogue No. 33226, United States National Museum.

Described from one male and five females.

SYLEPTA BERAMBALIS sp. nov. Plate 3, fig. 3.

Male.—Antenna with scale tooth at base, the basal half of shaft with small clusters of cilia; legs normal. Body and wings above buffy brown; body underneath white. Fore wing: markings fine, fuscous; a faint wavy, inbent antemedial line; a small point in cell; a fine oblique bar on discocellular; postmedial line punctiform, slightly outbent from below costa, outcurved from vein 5 to near vein 2, inbent and slightly outcurved to inner margin; terminal half of cilia grayish. Hind wing with a medial punctiform line, well outcurved from vein 5 to vein 2; area below cell to inner margin and to near termen with rather long hairs. Wings below light buff suffused with avellaneous, chiefly on termen; lines as above, buffy brown; faint lines on discocellulars.

Expanse, 41 millimeters.

Habitat.—Surigao, Mindanao.

Type.—Catalogue No. 33227, United States National Museum.

SYLEPTA PETROALIS sp. nov. Plate 3, fig. 4.

Female.—Head, palpi, and metathorax light buff, body otherwise above antimony yellow, the second segment of abdomen whitish, the other segments with white segmental lines; the preanal segment edged behind with black. Wings capucine buff, the markings hair brown; cilia silvery gray with a hair brown line at base. Fore wing: a fine outbent line antemedially from costa to inner margin; a subbasal fuscous small spot on inner margin; a point in cell, and line on discocellular; postmedial line outbent and incurved from costa to vein 5, then outbent and dentate to close to vein 2, inbent and downturned to inner margin; smoky brownish suffusions through cell and on terminal area, leaving a clear capucine buff terminal line. Hind wing suffused with smoky brownish except on inner margin; a line on discocellular; postmedial line well upbent below vein 3; terminal line as on fore wing. Wings below light buff, the termen suffused with hair brown, the lines well marked; no antemedial line on fore wing.

Expanse, 24 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33228, United States National Museum.

A series in the National Museum.

SYLEPTA SIMEALIS sp. nov. Plate 1, fig. 1.

Male.—Palpi fuscous, white underneath. Head white with a blackish spot on frons. Body above mustard yellow; a fuscous line on front of collar and shoulders; abdomen with whitish segmental lines, and some subdorsal fuscous scaling anteriorly on second and third segments, also a transverse line on preanal segment. Body below silvery white. Wings mustard yellow, the markings mostly fuscous; cilia silvery white with grayish olive shades. Fore wing; costal margin deep grayish olive; a spot at base of cell; a fine subbasal vertical line; antemedial line fine, outbent, followed by a spot across cell, and a point below cell; a deep grayish olive line on discocellular edged on both sides with black; postmedial line incurved to vein 5, then outbent, finer, dentate to vein 2, retracted to vein 3 suffusing with a small dark shade at base of veins 3 to 5, incurved to submedian and outcurved across it; some olivaceous suffusions on termen. Hind wing: a thick line on discocellular; postmedial line incurved at costa to vein 5, then outbent and slightly incurved between veins 5 and 2, retracted and downbent to inner margin; a dark shade at apex. Wings below whitish buff, the markings fainter.

Expanse, 31 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33229, United States National Museum.

Described from several specimens; an unnamed specimen in the British Museum.

SYLEPTA ELPHEGALIS sp. nov. Plate 3, fig. 6.

Male.—Body and wings light brownish olive (type). Abdomen with seventh segment overlain in front with white hair. Palpi and body below white; legs white streaked above with light brownish olive; fore tarsi with similar rings. Fore wing: lines blackish; antemedial outbent to median, then vertical; a fuscous streak on discocellular; postmedial almost vertical to vein 2, slightly retracted and faintly inbent to inner margin; a pale line at base of cilia which are tipped with grayish. Hind wing with postmedial line and cilia as on fore wing. Wings below light drab; postmedial line fainter; a dark line on discocellulars of both wings.

Expanse, 28 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33230, United States National Museum.

Some specimens are darker. The species is easily recognized by the white hairs on abdomen.

SYLEPTA AZADESALIS sp. nov. Plate 3, fig. 7.

Male.—Head, thorax, base of abdomen, and wings hair brown; abdomen otherwise dorsally fuscous black with fine whitish segmental lines; all the tarsi with light buff rings. Fore wing: lines fuscous black, the antemedial from subcostal slightly outbent, more heavily marked on veins; a spot on discocellular; postmedial thick, vertical from costa to below vein 6, bluntly outcurved and coarsely dentate to vein 2, retracted toward cell and vertical to inner margin, outwardly defined by faint paler shading; a fine pale line at base of cilia, followed by a blackish shade, the tips glossy hair brown. Hind wing: postmedial line fuscous black, outwardly well edged with pinkish buff, but less so at the projecting dentate line between veins 2 and 5; terminal line and cilia as on fore wing. Wings below paler, more of a drab, the lines as above.

Expanse, 28 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33231, United States National Museum.

A long series of specimens in the National Museum.

The male has no special characters.

SYLEPTA MACAREALIS sp. nov. Plate 3, fig. 8.

Male.—Body and wings above buffy brown; palpi and legs light drab. Wings: lines fine, black; a fine pale line at base of cilia which are concolorous with the wing. Fore wing: antemedial line hardly perceptible, slightly outcurved from subcostal; an oblique line on discocellular; postmedial line gently outcurved, macular from costa to vein 2, angled and slightly inbent to inner margin, the point at angle more heavily marked. Hind wing: postmedial line macular, slightly outcurved. Abdomen and wings below whitish buff suffused with drab; black points on discocellulars; postmedial line blackish brown, more distinctly punctiform.

Expanse, 31 millimeters.

Habitat.—Surigao, Mindanao.

Type.—Catalogue No. 33232, United States National Museum. Described from one male, two females presented to the National Museum by Mr. B. Preston Clark.

SYLEPTA MILDREDALIS sp. nov. Plate 2, fig. 9.

Female.—Body and wings above wood brown; base of palpi and throat white; body below light buff; fore legs hair brown with white rings; mid and hind legs chiefly light buff. Wings: lines fine, darker brown; a pale line at base of cilia. Fore wing: a sinuous antemedial line from median to inner margin; a point in cell; a short streak on discocellular; postmedial line inbent from costa, bluntly outcurved from below vein 5 to vein 2, retracted toward end of cell, angled and sinuous to inner margin. Hind wing with postmedial line bluntly outcurved between veins 5 and 2. Wings below buffish avellaneous; dark lines on discocellulars; postmedial somewhat punctiform, with a more prominent point at vein 5, below 5 not so bluntly outcurved.

Expanse, 32 to 37 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33233, United States National Museum. Two females received from Professor Baker.

SYLEPTA DOTTOALIS sp. nov. Plate 1, fig. 2.

Male.—Head white, palpi partly shaded with wood brown. Collar and thorax white with some olive brown scaling. Abdomen white at base and on terminal segments; a carob brown spot on first segment, the next three segments hazel with a dorsal black line. Body below and legs white. Fore wing: a black line from costa at one fourth to inner margin near tornus where it is sharply angled and inbent along inner margin to a vertical black antemedial line, the space within this triangle has a white line on submedian vein and is otherwise irrorated with lilac gray; some black and white scaling at base limited by an irregular black subbasal line, followed to antemedial line by a light buff space irrorated with brown; beyond the oblique line the costa is white, below it semihyaline cream white; a fine brown line on discocellular; a straight subterminal line, from costa near apex to vein 2, fine, fuscous; a fine brown line along vein 7 from cell to subterminal line; termen white with wood brown suffusions; a fine terminal brown line; cilia white. Hind wing: base and inner margin light buff suffused with wood brown; a fuscous black bar on discocellular; subterminal line fuscous black from costa to vein 2, retracted as a line of scales to bar on discocellular and downcurved to inner margin above a white patch at tornus; terminal area white suffused with wood brown except along a terminal dark brown line. Wings below white with the postmedial from costa to vein 2 only.

Expanse, male, 23 millimeters; female, 25.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33234, United States National Museum.

Near *S. chalybifascia* Hampson.

This species belongs to a section with the frons greatly produced.

MARGARONIA BAKERIALIS sp. nov. Plate 3, figs. 1 and 2.

Male.—Palpi natal brown, the base, a medial band, and tips ochraceous buff. Head hair brown, the frons laterally ochraceous buff. Collar and thorax benzo brown; an antilateral ochraceous buff line on collar extending shortly on tegulæ. Abdomen above verona brown mottled with sayal brown; anal segment metallic dark neutral gray, with silvery white shading; body below fuscous with some metallic blue scaling on terminal segments, the base with some ochraceous buff hairs; legs ochraceous buff circled with fuscous. Wings natal brown. Fore wing: base of costa ochraceous buff crossed by a black bar to median vein, an outset darker brown shade above inner margin; ochraceous buff streaks on either side of the two lines at costa, with the costal edge between the lines also ochraceous buff; antemedial line thick, slightly curved, and outbent, fuscous; a pale point in cell; postmedial line fuscous, thick, vertical from costa, inbent at vein 5, inclosing a small whitish spot, then downbent vertically close to middle of inner margin. Hind wing: a white line on discocellular, closely followed by a black median line outwardly shaded with ochraceous buff to near anal angle. Wings below grayish drab. Fore wing: an oblique antemedial creamy white streak from subcostal to median vein; a point in cell, and a creamy white streak beyond cell from subcostal to vein 5. Hind wing: a white line on discocellular, and faint traces of the medial line.

Female.—Fore wing: the markings on costa deep chrome, more extended forming a complete subbasal line, on outer edge of antemedial reaching median vein, almost completely inclosing a natal brown spot; the postmedial is downbent to vein 3, curved and upbent basad to subcostal near middle of wing, the space within curve deep chrome on costa, below it to vein 3 maize yellow. Hind wing: a large oval maize yellow spot about discocellular, the medial line from vein 6 black edged on either side, but not completely with orange buff. Wings below with the spots maize yellow, as large as above.

Expanse, male, 35 millimeters; female, 38.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33235, United States National Museum.

Some males have the ochraceous costal markings almost obsolete. I take special pleasure in naming this fine species in honor of Prof. C. F. Baker.

MARGARONIA LUPINALIS sp. nov. Plate 2, fig. 7.

Female.—Body and wings above silky dark vinaceous drab; edge of palpi below, throat, and body white; venter suffused with buff white. A white line on either side of frons crosses vertex and collar, expanding on tegulæ; some white shading on basal segment of abdomen. Fore wing: an oblique white fascia from subcostal, narrowing at submedian, expanding below submedian into a small triangular spot; a postmedial oval white spot from below costal edge to vein 2; a fine white postmedial line expanding on costal edge; both antemedial fascia and postmedial spot edged with dusky drab; cilia partly tipped with white. Hind wing white on basal half; a dusky drab streak on discocellular; a postmedial white line from costa to termen close to anal angle, broadly edged inwardly with dusky drab; a dusky drab line along inner margin from base to anal angle. Wings below similar, the dark portion benzo brown.

Expanse, 25 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33236, United States National Museum.

Near *M. bicolor* Swains, distinguished by the complete white postmedial line, and streak on discocellular of hind wing.

CLINIODES TOTUANALIS sp. nov. Plate 3, fig. 5.

Female.—Head white; palpi rufous, underneath white at base; antennæ light drab, the first joint white. Collar and thorax opalescent pale drab gray, the former with a narrow yellow ocher band in front extending on shoulders. Abdomen silvery white, the dorsum largely light drab. Body below and legs white, the fore tarsi light ochraceous buff. Fore wing silvery drab tinged with olivaceous; costa yellow ocher with a dark shade on it from base to near middle, below subcostal a silvery white line to near apex with a projecting small triangular white spot at end of cell. Hind wing; costa silvery white, otherwise suffused with light drab. Fore wing below hair brown, the costa except edge, basal half, and inner margin white. Hind wings below white, the termen narrowly hair brown.

Expanse, 27 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33237, United States National Museum.

Close to *C. subcostalis* Walker from Borneo.

CROCIDOLOMIA SUBHIRSUTALIS sp. nov. Plate 2, fig. 10.

Male.—Palpi Hay's brown, the tips of each joint white; head white crossed by three brown lines; collar white with brown patches; thorax mottled brown and white, the tegulæ white with brown spots; abdomen above white at base, otherwise fuscous with white segmental lines; body below white. Fore wing mostly buffy brown with blackish brown irrorations medially in and below cell; white mottling at base; an antemedial interrupted white vertical line defined by brown scales; costa and front of cell medially, white, also the submedian and median veins; on discocellular an excurved white line with dark brown edges, the anterior edge expanding; postmedial line well outcurved lunular dentate, white, inwardly edged with black from costa to vein 4; costal edge warm buff; terminal area mottled with white; a marginal lunular white line, preceded by brown spots, outwardly edged by the black terminal line which is slightly indentate at veins; cilia brown with silvery shading. Hind wing hair brown; costa, base, and cell whitish; cilia light buff tipped with white. Wings below buff-white; fore wing with a broad outer fuscous fascia to near termen; the tufts below cell prominent.

Expanse, 25 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33238, United States National Museum.

More variegated than *C. suffusalis* Hampson.

SAMEODES FINBARALIS sp. nov. Plate 1, fig. 6.

Female.—Body above warm buff, underneath white; fore and mid tibiæ and tarsi warm buff; hind tibiæ and tarsi white. Fore wing naples yellow. Hind wing semihyaline white faintly suffused with naples yellow.

Expanse, 29 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33239, United States National Museum.

SAMEODES ULRICALIS sp. nov. Plate 1, fig. 7.

Male.—Body avellaneous above, underneath white; legs avellaneous above, white below. Fore wing pinkish buff, the markings dark vinaceous drab; an interrupted streak on base of costa; a thick antemedial line slightly curved, followed by an elongated spot to below the large round discocellular spot; postmedial broad from below costa close to discocellular spot well outcurved, its inner edge diffuse below vein 3; cilia tipped with silvery white. Hind wing semihyaline white, suffused with light buff.

Expanse, 25 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33240, United States National Museum.

Hind wing below without the large fovea.

Several specimens in the National Museum, and an unnamed specimen in the British Museum.

SAMEODES ALEXALIS sp. nov. Plate 1, fig. 8.

Male.—Body and wings pale orange yellow; fore tibiæ tipped with black, the fore tarsi with white rings. Fore wing: a black spot at base of cell; a vertical antemedial dark vinaceous drab line, narrow on costa, expanding to inner margin where it extends to postmedial which is narrow on costa, vertical on inner edge, outbent on outer edge to near termen above tornus, and abruptly inbent, leaving the terminal portion of inner margin orange yellow; a small black spot at cell over veins 3 and 4. Hind wing: postmedial dark vinaceous drab, narrow on costa, below vein 6 expanding and inbent to inner margin, bluntly projecting below vein 3. Wings below with the postmedial markings only, reduced and fainter.

The female similar.

Expanse, 27 millimeters.

Habitat.—Los Baños; Mount Maquiling, Luzon.

Type.—Catalogue No. 33241, United States National Museum.

Belongs to section II.

SAMEODES ODULPHALIS sp. nov. Plate 1, fig. 9.

Male.—Body and wings pale orange yellow. Tip of fore tibiæ fuscous, the tarsi with white rings; mid and hind tibiæ white. Fore wing: a small black spot at base of cell and a slightly larger spot covering the base of veins 3 and 4. Hind wing with inner margin silvery white.

Expanse, 26 millimeters.

Habitat.—Los Baños, Luzon.

Type.—Catalogue No. 33242, United States National Museum.

Belongs to section II (*Mimorista* Ware).

Three males received from Prof. C. F. Baker.

SAMEODES ENNODUISALIS sp. nov. Plate 1, fig. 10.

Female.—Body and wings light orange yellow, also the legs except fore tibiæ and tarsi which are like those of *S. odulphalis.* Fore wing: a small black spot at base of cell, and a slightly larger spot over base of veins 3 and 4; black antemedial and medial spots on inner margin and a small subterminal spot on vein 3. Hind wing below with a black medial spot on costa.

Expanse, 27 millimeters.

Habitat.—Mount Maquiling, Luzon.

Type.—Catalogue No. 33243, United States National Museum.

This may eventually prove to be the female of *S. odulphalis.*

POLYGRAMMODES EPHREMALIS sp. nov. Plate 1, fig. 11.

Male.—Head and body white; a hair brown spot on palpi; slight brownish suffusion on middle of frons; collar and tegulæ with some light buff suffusions; abdomen with segmental vinaceous buff lines, on second segment a chestnut brown line; anal hairs black. Fore wing buff white; a basal spot on median, subbasal spots on costa and inner margin and thick antemedial and medial lines, blackish brown; antemedial outcurved; medial line from a streak on costa outbent across discocellular, vertical and sinuous below it, preceded by a point in cell; postmedial line finer, browner, angled on subcostal, vertical to vein 5, outset and slightly inbent to vein 2, below vein 2 an irregular spot narrowing on inner margin, a subterminal macular paler line, slightly outset below vein 5; a terminal olive brown line. Hind wing whiter, thinly scaled; faint dark scaling at lower angle of cell with a downbent line below it; postmedial fine, slightly outset at vein 5 and vein 2, from which point it is somewhat broader; a subterminal line from costa to vein 2; terminal line very fine.

Expanse, 38 millimeters.

Habitat.—Surigao, Mindanao; Mount Maquiling, Luzon.

Type.—Catalogue No. 33244, United States National Museum.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Sylepta simealis* sp. nov.
2. *Sylepta dottoalis* sp. nov.
3. *Phostria celsusalis* sp. nov.
4. *Dichocrocis galmeralis* sp. nov.
5. *Dichocrocis dorsipunctalis* sp. nov.
6. *Sameodes finbaralis* sp. nov.
7. *Sameodes ulricalis* sp. nov.
8. *Sameodes alexalis* sp. nov.
9. *Sameodes odulphalis* sp. nov.
10. *Sameodes ennoduisalis* sp. nov.
11. *Polygrammodes ephremalis* sp. nov.
12. *Pilocrocis polialis* sp. nov.

PLATE 2

FIG. 1. *Phostria primulosalis* sp. nov.
2. *Phostria hillalis* sp. nov.
3. *Sylepta banosalis* sp. nov.
4. *Phostria aengusalis* sp. nov.
5. *Lamprosema alicialis* sp. nov.
6. *Phostria druonalis* sp. nov.
7. *Margaronia lupinalis* sp. nov.
8. *Lamprosema bonitalis* sp. nov.
9. *Sylepta mildredalis* sp. nov.
10. *Crocidolomia subhirsutalis* sp. nov.

PLATE 3

FIG. 1. *Margaronia bakerialis* sp. nov., female.
2. *Margaronia bakerialis* sp. nov., male.
3. *Sylepta berambalis* sp. nov.
4. *Sylepta petroalis* sp. nov.
5. *Cliniodes totuanalis* sp. nov.
6. *Sylepta elphegalis* sp. nov.
7. *Sylepta azadesalis* sp. nov.
8. *Sylepta macarealis* sp. nov.
9. *Sylepta cathanalis* sp. nov.

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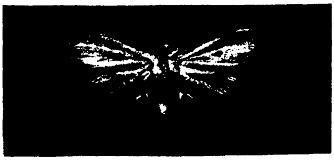

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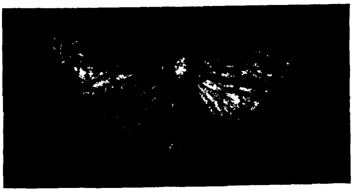

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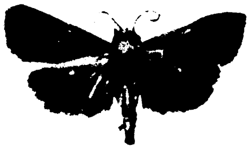

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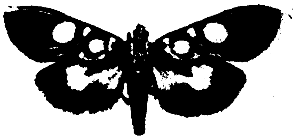

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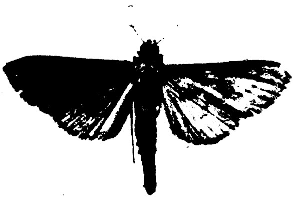

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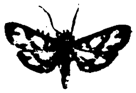

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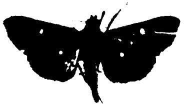

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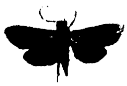

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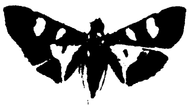

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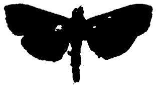

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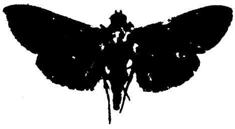

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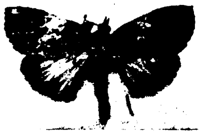

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PLATE 2.

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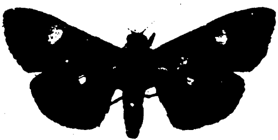

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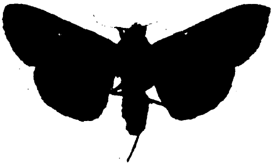

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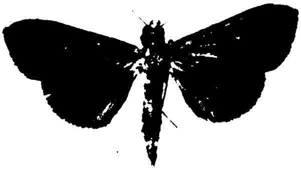

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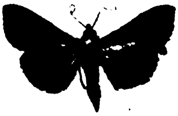

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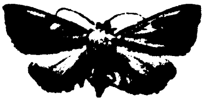

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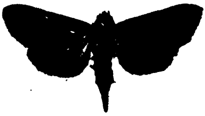

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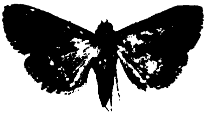

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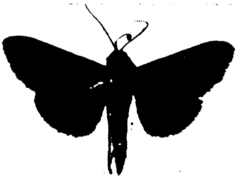

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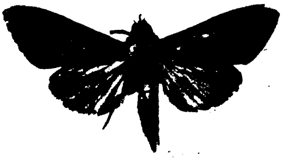

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PLATE 3.

NIV.
OF
CH

DIE CONOPIDEN DER PHILIPPINEN

VON O. KRÖBER

Hamburg, Germany

EINE TAFEL

Als ich 1915 meine erste Arbeit über orientalische Conopiden schrieb, hatte mir von den Philippinen noch keine einzige Art vorgelegen. Durch Prof. M. Bezzi [1] ist dann die erste neue Art daher bekannt gemacht worden, *Stylogaster bakeri.* Heute liegt mir eine kleine Collektion von 40 Exemplaren vor, die sich auf 7 Arten verteilen, von denen 4 neu sind. Es scheint mir, als ob die Inseln des Orients überhaupt zu einer regen Neubildung von Arten und Unterarten neigen, so dass von diesen Gebieten noch viel neues und interessantes zu erwarten sein dürfte. Die vorliegenden Conopiden gehören nur 2 Gattungen an, während im ganzen aus der orientalischen Region 9 Gattungen mit 70 Arten bekannt sind. Dieselben verteilen sich folgendermassen: *Brachyceraea,* 1 Art; *Physocephala,* 22 Arten; *Conops,* 29; *Zodion,* 3; *Myopa,* 5; *Occemyia,* 5; *Sicus,* 2; *Stylogaster,* 2; und *Macroconops,* 1 Art.

Übersicht über die Unterfamilien und Gattungen.

1. Drittes Fühlerglied mit Endgriffel........................ Unterfamilie **Conopinæ.**
   Drittes Fühlerglied mit Rückenborste.. 2.
2. Untergesicht stark gekielt, ohne Gesichtsgruben. Rüssel sehr auffallend lang und dünn; die Lippen lang fadenförmig, oft nach aussen umgerollt. Fühlerborste deutlich 3-gliedrig. Körper sehr lang und zart. Weib mit lang vorstehender Legeröhre.... Unterfamilie **Stylogasterinæ.** (Nur 1 Genus, *Stylogaster,* mit 2 Arten, *S. bakeri* Bezzi und *orientalis* Brun.)
   Untergesicht nie gekielt. Rüssel nie auffallend dünn und lang, oft sehr kurz, fast in der Mundhöhle verborgen. Fühlerborste 2-gliedrig. Weib mit unpaarem Organ (Theka) an der Bauchseite. Mann ohne fadenförmigen Anhang der Genitalien. Körper stets walzig, gedrungen .... Unterfamilie **Myopinæ.**

Unterfamilie Conopinæ.

1. Drittes Fühlerglied nie das längste. Rüssel stets länger als der Kopf, stets chitinös, glänzend.. 3.

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[1] Philip. Journ. Sci. 12 § D (1917) 157.

2. Drittes Fühlerglied weitaus das längste.............. **Pleurocericlla** Brunetti.
3. Endglied des Fühlergriffels blattförmig, abgeplattet. Zweites und drittes Fühlerglied nahezu gleichlang. Abdominalspitze des Weibes nicht hakenförmig, sondern ein gleichmässig verjüngter Kegel.
Macroconops Kröber.
Endglied des Fühlergriffels borstenförmig. Analsegment des Weibes hakig umgebogen .... 4.
4. Die kleine Flügelquerader steht hinter der Mitte der Discalzelle, mehr in ihrem letzten Drittel (flügelspitzenwärts). Erste Hinterrandzelle kurz. Hinterleib bedeutend länger als Kopf und Thorax zusammen, beim Mann besonders dünn gestielt. f und t mit merkwürdigen Schwellungen .... **Physocephala** Schiner.
Die kleine Querader steht auf der Mitte der Discalzelle. Erste Hinterrandzelle sehr lang gestreckt.. 5.
5. Fühler kurz, kaum kopflang, mit rundlichem Endglied. Griffel 3-gliedrig.
Brachyceraea v. Röd.
Fühler mindestens kopflang, meistens viel länger, mit spatelförmigem Endglied. Griffel oft nur 2-gliedrig............................ **Conops** Linnæus.

MYOPINÆ[2]

1. Rüssel nur an der Basis gekniet... **Zodion** Latreille.
Rüssel an der Basis und in der Mitte gekniet.. 2.
2. Untergesicht stark verlängert, weit unter die Backen heruntergehend. Backen wenigstens doppelt so lang als der Augendurchmesser. Hinterleib bedeutend kürzer als die Flügel, oben plattgedrückt.
Myopa Fabricius.
Untergesicht nur mässig verlängert; Backen höchstens so lang wie der Augendurchmesser .... 3.
3. Fühler viel länger als ihr Abstand vom Scheitel, meistens kopflang. Kleine schwarze oder graue Arten mit nie ganz rotgelber Stirn. Hinterleib kurz, namentlich im Weib...... **Occemyia** Robineau-Desvoidy.
Fühler viel kürzer als ihr Abstand vom Scheitel. Grosse, rostbraun gefärbte Arten mit ganz rotgelber Stirn. Hinterleib des Weibes schmal, lang, weit umgebogen.. **Sicus** Scopoli.

ÜBERSICHT ÜBER DIE BISHER BEKANNT GEWORDENEN ARTEN

Physocephala albofasciata BRUN., ♂ ♀, Rec. Ind. Mus. 7 (1912) 497. Ind. or.

Physocephala ammophiliformis KRÖB., ♂, Archiv f. Naturg. 81 (1915) 122, t. 4, f. 25. Birma.

Physocephala annulifera BRUN., ♂, Rec. Ind. Mus. 7 (1912) 498. Assam.

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[2] Die Gattung *Pleurocericlla* Brunetti, die nach der Zeichnung eine echte Conopinæ mit Fühlergriffel ist, characterisiert der Autor folgendermassen: "3. antennal joint conspicuously long, more than twice as long as 2., subcylindrical, with distinct apical style." Ozellen finden sich auch bei Conopiden. Die Gattung würde m. E. zur ersten Unterfamilie gehören. (s. o.)

Physocephala argentifera BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 361. Bengalen.

Physocephala assamensis KRÖB., ♀, Archiv f. Naturg. 81 (1915) 121. Assam.

Physocephala atricornis BRUN., ♂, Fauna Brit. Ind. 3 (1923) 363. Lahore.

Physocephala aterrima KRÖB., ♂ ♀, Archiv f. Naturg. 81 (1915) 122. Sikkim.

Physocephala aurantiaca BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 358. Bengalen, Ceylon.

Physocephala aureopygia KRÖB., ♂ ♀, Archiv f. Naturg. 81 (1915) 123, 131. Sikkim, Australia.

Physocephala bicolor BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 357. Darjeeling, Nepal.

Physocephala bipartita DOL., ♂ ♀, Nat. Tijd. Ned. Ind. 17 (1858–1859) 100. Amboina, Sumatra, Palong Pegu.

Physocephala calopa BIG., ♂ ♀, Ann. Soc. Ent. France VI 7 (1887) 334. Pondicherry.

Synonym, *mundus* BRUN., Fauna Brit. Ind. 3 (1923) 361 [Conops]. Ind. or.

Synonym, *quadrata* BRUN., Rec. Ind. Mus. 9 (1913) 274. Ost Himalaya.

Physocephala diffusa BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 365. Bengalen.

Physocephala limbipennis MEIJ., ♂ ♀, Tijd. v. Ent. 53 (1910) 165. Bali, Semarang, Krakatau, Formosa.

Synonym, *annulata* KRÖB., ♂ ♀, Ent. Mitt. Berlin 2 (1914) 281; Archiv f. Naturg. 80 (1914) 60, und 81 (1915) 124.

Synonym, *amoena* i. l.

Physocephala lugens VOLL., Versl. Meded. K. Akad. Wetensch., 15 (1863) 10, f. 5. Borneo.

Physocephala nigrofasciata BRUN., ♂, Rec. Ind. Mus 7 (1912) 497. Koygar.

Physocephala nursei BRUN., ♂, Fauna Brit. Ind. 3 (1923) 360. Ind. or.

Physocephala rufescens BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 360. Kaschmir.

Physocephala sauteri KRÖB., ♂ ♀, Entom. Mitt. Berlin 2 (1913) 280. Formosa.

Physocephala scutellata KRÖB., ♂, Archiv f. Naturg. 81 (1915) 118. Birma.

Physocephala sumatrensis KRÖB., ♀, Archiv f. Naturg. 81 (1915) 119. Sumatra.

Physocephala tenella BIG., ♂ ♀, Ann. Soc. Ent. France VI 7 (1887) 35. Ceylon, Ind. or.

Brachyceraea obscuripennis KRÖB., ♂ ♀, Entom. Mitt. Berlin 2 (1913) 277. Formosa.

Conops annulosus BIG., ♂ ♀, Ann. Soc. Ent. France VI 7 (1887) 36. Molukken, Birma.

Conops brevirostris KRÖB., ♀, Archiv f. Naturg. 81 (1915) 53. Birma.

Conops celebensis MEIJ., ♂ ♀, Tijd. v. Ent. 53 (1910) 165. Celebes, Sikkim.

Conops claripennis BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 345. Ind. or.

Conops claripennis var. **ceylonicus** BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 346. Ceylon.

Conops erythrocephalus F., ♂ ♀, Ent. Syst. 4 (1850) 392. Ind. or., franz. Guinea, Lorenzo Marques.

Conops frontosus KRÖB., ♂, Archiv f. Naturg. 81 (1915) 57. Sikkim.

Conops gigas MACQ., ♀, Dipt. Escot. II 3 (1843) 10. Java.

Conops indicus KRÖB., ♂ ♀, Archiv f. Naturg. 81 (1915) 45. Sikkim.

Conops intermedius BRUN., ♂, Fauna Brit. Ind. 3 (1923) 353. Ind. or.

Conops javanicus DOL., ♂ ♀?, Nat. Tijdsch. Ned. Ind. 10 (1856) 409, t. 4, f. 2. Java.

Conops maculiventris KRÖB., ♂ ♀, Archiv f. Naturg. 81 (1915) 50. Sikkim, Birma.

Conops morosa MEIJ., ♂ ♀, Tijd. v. Ent. 67 (1924) 213. Java.

Conops nigripes KRÖB., ♂ ♀, Entom. Mitt. Berlin 2 (1913) 278. Formosa.

Conops nigriventris BRUN., ♂, Fauna Brit. Ind. 3 (1923) 346. Assam.

Conops nigrofasciatus KRÖB., ♀, Archiv f. Naturg. 81 (1915) 46. Rangoon.

Conops nubeculosus BIG., ♂ ♀, Ann. Soc. Ent. France VI 7 (1887) 36. Ind. or., Australia.

Conops nubeculosus var. **fulvicornis** KRÖB., ♂, Entom. Mitt. Berlin 2 (1913) 279. Formosa.

Conops nubeculosus var. **ornatus** BIG., ♀, Bull. Soc. Zool. de France 17 (1892) 211. Ind. or.

Conops pactyas WALK., ♂ ♀, Dipt. Saund. 4 (1852) 255. Java, Birma.

Conops pseudogigas KRÖB., ♂, Archiv f. Naturg. 81 (1915) 55. Birma.

Conops punctifrons KRÖB., ♀, Archiv f. Naturg. 81 (1915) 52. Sikkim.

Conops rufifrons DOL., ♂ ♀, Nat. Tijdschr. Ned. Ind. 14 (1857) 412, t. 8, f. 1. Amboina.

Conops rufofasciatus BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 353. Simla.

Conops rufomaculatus KRÖB., ♂ ♀, Archiv f. Naturg. 81 (1915) 44. Formosa.

Conops sepulchralis BRUN., ♂, Fauna Brit. Ind. 3 (1923) 348. Assam.

Conops sumatrensis KRÖB., ♀, Archiv f. Naturg. 81 (1915) 49. Sumatra.

Conops teuthrediniformis KRÖB., ♂, Archiv f. Naturg. 81 (1915) 51. Birma.

Conops testaceus MACQ., Dipt. Exot. II 3 (1843) 9. Bengalen, Tasmania.

Zodion cinereum F., ♂ ♀, Ent. Syst. 4 (1794) 319. Simla, Europa.

Zodion griseum BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 375. Kaschmir.

Zodion montanum BRUN., ♀, Rec. Ind. Mus. 7 (1912) 499. Ind. or.

Myopa cincta F., ♂ ♀?, Ent. Syst. 4 (1794) 399. Ind. or.

Myopa dorsalis F., ♂ ♀, Ent. Syst. 4 (1794) 397. Bihar, Europa, Afrika sept.

Myopa nigriventris BRUN., ♂, Fauna Brit. Ind. 3 (1923) 380. Kaschmir.

Myopa picta PZ., ♂ ♀, Fauna German. 114 (1798) 22. Ind. or., Europa, Afrika sept.

Myopa testacea L., ♂ ♀, Syst. Nat. ed. 11 2 (1759) 1006. Kaschmir, Europa, Afrika sept.

Occemyia atra F., ♂ ♀, Spec. Ins. 2 (1781) 469. Simla, Europa, Afrika sept.

Occemyia caenovalva KRÖB., ♀, Archiv f. Naturg. 81 (1915) 104, t. 7, f. 49. Formosa.

Occemyia flavipes BRUN., ♀, Fauna Brit. Ind. 3 (1923) 383. Bombay.

Occemyia sauteri KRÖB., ♂ ♀, Archiv f. Naturg. 81 (1915) 103. Formosa.

Occemyia simillima MEIJ., Bijdragen tot de Dierkunde 18 (1914) 103. Java.

Sicus ferrugineus L., ♂ ♀, Fauna Suec. (1761) 1907. Sikkim, Europa.

Sicus vaginalis KRÖB., ♀, Archiv f. Naturg. 81 (1915) 88, t. 7, f. 51. Ind. or.

Stylogaster bakeri BEZZI, ♂ ♀, Philip. Journ. Sci. § D 12 (1917) 157. Philippinen.

Stylogaster orientalis BRUN., ♂, Fauna Brit. Ind. 3 (1923) 372. Ind. or., Ceylon.

Pleurocerieila dioctriaeformis BRUN., ♂ ♀, Fauna Brit. Ind. 3 (1923) 368. Simla.

Vorstehende Liste enthält noch alle bisher nicht gedeuteten Arten älterer Autoren, die nur auf Grund des Typenmaterials identifiziert werden könnten, von denen zum Teil nicht einmal klar angegeben werden kann, ob ihr Platz in der betreffenden Gattung berechtigt ist.

Dieser verhältnismässig grossen Zahl orientalischer Conopiden gegenüber ist die der Philippinen bis jetzt nur bescheiden zu nennen. Nur fünf der bekannten Arten sind in der vorliegenden Collektion enthalten, doch kommen vier neue Spezies dazu: *Physocephala bipartita* Dol., ♂ ♀; *P. limbipennis* Meij., ♂ ♀; *P. philippinensis* sp. nov., ♂ ♀; *Conops bakeri* sp. nov., ♂ ♀; *C. nubeculipennis* Big., ♀ (var.); *C. nubeculipennis* var. *ornatus* Big., ♀; *C. olivaceus* sp. nov., ♂ ♀; *C. philippinensis* sp. nov., ♂; und *Stylogaster bakeri* Bezzi, ♂ ♀.

Das gesammte Material ist von Herrn Prof. Baker persönlich zusammengetragen und ist in vorzüglichem Erhaltungszustand, so dass zu manchen Beschreibungen älterer Arten ergänzende Zusätze gemacht werden können.

Genus PHYSOCEPHALA Schiner

Bestimmungstafel der Physocephala-Arten.

1. Die Flügelbinde ist vor der Spitze plötzlich abgebrochen; Flügelspitze absolut hyalin .... **P. limbipennis** de Meijere.
   Die Flügelbinde reicht bis zur Spitze selber; also die ganze Unterrandzelle ist braun .... 2.
2. Kleine zarte Art mit wenig intensiven Schillerbinden. Flügelborderrand bis r_3 braun .... **P. bipartita** Doleschall.
   Grosse (12 bis 18 mm[3]) tiefschwarze Art mit intensivem Goldschimmer an Kopf und Thorax. Flügelbinde sehr dunkel, bis r_5 reichend. **P. philippinensis** sp. nov.

PHYSOCEPHALA LIMBIPENNIS de Meijere.

Zwei Männer: Cuernos Mountains, Negros; 8 Männer: Cuernos Mountains; Malinao, Tayabas; Dapitan, Mindanao.

Mann, Länge 7.2 bis 8 mm; Fühler fast 1 bis 1.3 mm; Flügellänge 4.5 bis 5.5 mm; Flügelbreite 1.1 bis 1.7 mm.

Untergesichtsmitte fast glänzend schwarz. Zweites Fühlerglied durch die dichte Beborstung der Oberseite und Spitze fast schwarz erscheinend. Endgriffel sehr kurz. Spitze und Seitenfortsatz fast gleich lang. Toment des Mesonotums und Abdomens durchaus silberweiss (nicht goldgelb). Hinterleib dünn gestielt, schwarzbraun, nur die Grenze des zweiten und dritten Tergits roströtlich. Flügel absolut hyalin. Das Ende der Discalzelle und Unterrandzelle hinter der plötzlich abgebrochenen Binde ohne jede Spur von Braunfärbung. f_3 mehr als zur Hälfte braunschwarz, k schwarz; Metatarsus der p_1 und p_2 heller.

Weib, Länge 6 bis 8.5 mm; Fühler 1.1 bis 1.5 mm; Flügellänge 5 bis 6 mm; Flügelbreite 1.3 bis 2 mm.

In der Färbung stark variabel! Theka in der Regel rostrot, zuweilen ganz schwarzbraun, stark glänzend. Schwinger sattgelb mit braunem Stiel. Hinterleib ganz schwarzbraun, mit blassgelblichem oder rein silberweissem Schiller. f_3 fast ganz schwarzbraun, t_3 schwarzbraun mit weisslicher Basis. Die letzten Segmente ziemlich lang und dicht schwarz behaart. Backen in der Regel braun. Ein Weib hat gelblichen Schiller auch auf den Seitenplatten des Hinterrückens und am Abdomen. Bei einem Weib sind die Gesichtsgruben ganz schwarzglänzend. Ein Weib von Mindanao ist vollkommen hell rostbraun mit gelblichem Schiller, nur die Thoraxplatte und das Schildchen sind schwarz. p braun, fast ohne jede Verdunkelung. Gesichtsgruben nur leicht gebräunt.

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[3] Die Länge der Tiara ist immer ohne die Fühler angegeben; letztere sind extra gemessen.

PHYSOCEPHALA BIPARTITA Doleschall.

Acht Männer: Dapitan, Surigao, Davao, Mindanao. Mount Maquiling, Luzon.

Sieben Weiber: Davao, Surigao, Kolambugan, Dapitan, Mindanao. Sibuyan.

Mann, Länge 9 bis 10 mm; Fühler 2 bis 2.2 mm; Flügellänge 6 bis 6.5 mm; Flügelbreite 1.7 bis 2 mm.

Weib, Länge 8 bis 9 mm; Fühler fast 2 bis 2.4 mm; Flügellänge 5.5 bis 7.2 mm; Flügelbreite 1.6 bis 2 mm.

Die Art ist ziemlich weit verbreitet und recht variabel, mit entschiedener Neigung zur Bildung von Lokalrassen, wozu die Isolierung der vielen Inselgruppen wohl beiträgt. Vielleicht bildet sie mit der vorigen und diversen andern Arten einen grossen Formenkreis. Von *limbipennis* Meijere unterscheidet sie sogleich die vollkommen braun tingierte Unterrandzelle.

Mann, Fühler hell rotgelb, drittes Glied etwas länger als das erste. Hinterkopf an den Seiten intensiv gelbschimmernd. Thorax vor dem Schildchen düster rotbraun. Schildchen schwarzbraun. Hinterrücken schwarz. Brustseiten rostbraun mit ziemlich scharf begrenzter gelber Schillerstrieme. Hüften schwarzbraun messinggelb glänzend. p rostrot. f oben mehr oder weniger verdunkelt, f_3 fast der Länge nach. Basis von t_3 fast weissgelb. Schwinger sattgelb, die äusserste Stielbasis bräunlich. Zweites und drittes Abdominalsegment an der Basis rostrot. Alle Hinterleibsschiller gelb.

In hellen Exemplaren ist der Hinterleib vorherrschend rostbraun, nur die Mitte der Segmente mehr oder weniger verdunkelt. p rostbraun, eigentlich ohne jede Verdunkelung. Manchmal liegt vor dem Schildchen eine intensiv goldgelbe Tomentbinde.

Weib gleicht in allem dem Mann. Helle Exemplare sind fast ganz rostbraun. Die Theka ragt etwas weiter vor als die Abdominalspitze. Dunkle Tiere sind fast ganz schwarzbraun mit schwarzbrauner Theka, aber die p sind dann auch rostrot. In einigen Weiber ist der Schiller des Hinterleibes prachtvoll goldgelb. Die Färbung der Flügelbinde schwankt zwischen hellbraun und schwarzbraun.

Sehr nahe steht entschieden *P. argentifera* Brun.

PHYSOCEPHALA PHILIPPINENSIS sp. nov.

Gehört in die nächste Verwandtschaft von *P. sauteri, ammophiliformis,* und *aterrima,* ist aber von allen deutlich verschieden.

Mann, Länge 18 mm; Fühler 3.4 mm; Flügellänge 11 mm; Flügelbreite 3.4 mm.

Kopf dunkel gelbbraun, ziemlich glanzlos. Stirn vor der Scheitelblase von Auge zu Auge dunkelbraun. Diese Zone verschmälert sich dann und endet als feiner senkrechter Strich am Fühlerhöcker. Untergesicht weisslichgelb mit kleiner Λ-förmiger schwarzglänzender Makel auf dem Kiel. Backen und Augenhinterrand dunkelbraungelb, letzterer intensiv goldgelbglänzend tomentiert. Hinterkopf im übrigen dunkelbraun. Fühlerhöcker tief schwarz. Ein hufeisenförmiger Fleck kommt dadurch zu Stande, dass zwei Streifen bis zur Höhe des Mittelflecks neben den Gesichtsgruben herabsteigen. Rüssel rostbraun mit schwarzer Spitze. Fühler lang und schlank, schwarz. Erstes und drittes Glied unterseits rostrot. Erstes ca. 3 mal so lang als breit; zweites ca. 2 bis 2.5 mal so lang als das erste; drittes so lang wie das erste. Endgriffel kurz zweispitzig. Thorax oben sammetschwarz. Schulterbeulen, Seiten- und Hinterrand mattbraun mit wundervoll intensivem Goldglanz. Der Schulterfleck findet seine Fortsetzung in einer breiten Binde der Brustseiten, die sonst glanzlos schwarzbraun sind. Schildchen mattschwarz mit reinbraunem Hinterrand. Hinterrücken tiefschwarz, oben schmal goldschimmernd, desgleichen auf den Seitenplatten. Schwinger sattgelb, die Knöpfchenspitze fast orange; äusserste Stielbasis bräunlich. Hüften schwarz mit fast weissgelbem, intensivem Schiller. p rostrot. Tarsen tiefschwarz. f und t mit äusserst kurzer, zerstreuter, angedrückter Beborstung. f zart weiss bestäubt. Aussenseite der t fast messinggelb glänzend. f_3 oben fast der Länge nach schwarz. t_3 seitlich weiss schimmernd. Haftläppchen gelblich. Klauen schwarz. Flügel etwas schwarzbräunlich getrübt mit tief schwarzbrauner Strieme, die vom Vorderrand bis zur Spitze und bis zur fünften Längsader reicht. Spitze der ersten Hinterrandzelle und Raum unterhalb dieser Zelle getrübt. Hinterleib sehr schlank, schwarzbraun, fast glanzlos. Vom Ende des zweiten Ringes an schwarz. Zweiter Ring fast die Hälfte des Körpers betragend. Ende des ersten etwas gelblich bereift, Ende des zweiten an den Seiten etwas goldgelb, nach oben schnell abnehmend. Das dritte und vierte ganz tief schwarz, glanzlos und glanzlos schwarz anliegend behaart. Analsegment weiss bestäubt, daher fast bläulich erscheinend.

Ein Mann von Samar.

Weib, Länge 12 bis 20 mm; Fühler 4 mm; Flügellänge 9.6 bis 11 mm; Flügelbreite 2.6 bis 3.1 mm.

Gleicht in allen Teilen dem Mann. Der Untergesichtsfleck ist kleiner. Rüssel fast ganz schwarz. Fühler von etwas andern Bau als beim Mann. t_1 unten der Länge nach verdunkelt durch die sehr dichte kurze Behaarung. Vordertarsen rostrot, durch schwarze Behaarung dunkel erscheinend. t_2 und t_3 und f_3 an der Oberseite weniger ausgedehnt schwarz. Die ganzen p eigentlich nur weiss bereift, ohne jeden intensiven Silberglanz. Hinterleib viel kürzer und robuster als beim Mann. Zweites und drittes Segment fast von gleicher Länge, braun, mit rötlichem Schein, fast glanzlos. Die Seiten sind fein weissgelb bestäubt am ersten bis dritten Tergit; die Mitte bleibt glanzlos in jeder Beleuchtung. Basis des dritten Tergits und die ganze Unterseite des dritten Sternits hellrostrot. Hinterrand des dritten Tergits jederseits mit scharf isoliertem blassmessinggelbem Tomentfleck. Vierter und fünfter Ring tief schwarz mit feinem bräunlichen Hinterrandsaum. Theka stark glänzend, schwarz, weiter vorragend als die Analspitze. Sechstes und siebentes Segment schwarz, etwas glänzend weiss bereift, daher bläulich erscheinend. Färbung der Flügel minder intensiv. Zweite Basalzelle fast hyalin, ebenso das Ende der ersten Hinterrandzelle. Flügelhinterrand vollkommen hyalin.

Zwei Weiber von Kolambugan und Surigao, Mindanao.

Von *P. bicolor* Brunetti unterscheidet sich die neue Art sofort durch den deutlich 2-gliedrigen Endgriffel, der bei *bicolor* 3-gliedrig sein soll, ferner durch gelbbraune, nicht schwärzliche Backen, rein schwarzen Thorax und Schildchen; Pleuren schwarz mit deutlicher goldgelber Strieme.

Bei der grossen Variabilität namentlich der *Physocephala* Arten aus der *pusilla*-Gruppe, ist es immer schwierig, Einzelstücke scharf vom Arttypus zu trennen. Wie ich bei den aegyptischen Arten nachweisen konnte lässt ein sehr reiches Material der verschiedensten Fundorte und Jahreszeiten manche Grenze verschwinden, die man auf Grund eines Einzelfundes in einem besonders isolierten Gebiet gezogen hat. So scheint mir auch bei *P. limbipennis* de Meijere die Variabilität zu verschiedenen andern Arten hinüberzuführen. *Physocephala annulifera* Brunetti, Mann, scheint sich nur durch belanglose Kleinigkeiten zu unterscheiden: eine ausgesprochene Stirnmakel, gelbes Toment, schwärzliche Schwinger. Eine Cotype von *limbipennis* de Meijere des Budapester Museums war in der Unterrandzelle bis zur Flügelspitze leicht braun, tingiert, würde also der Art *P. munda* Brunetti entsprechen oder doch ihr sehr nahe kommen: "wings-band dying away gradually at about tip of second vein." (Meine var. *amoena* i. l.) Ob auch *calopus* Bigelow zum Formenkreis von *limbipennis* gehört, vermag ich nicht zu sagen. Brunetti sagt: "Thorax brownish-yellow or orange brown;" Bigelow sagt: "Thorax schwarz, Pleuren rostrot." Nach der Originaldiagnose soll aber die Unterrandzelle grau sein, würde also überhaupt die *pusilla*-Gruppe ausscheiden, in der sie vollkommen braun ist.

Genus CONOPS Linnæus

Die von den Philippinen vorliegenden *Conops*-Arten machen die von mir aufgestellten provisorischen Gruppen unhaltbar, da sie in keine derselben so recht hineinpassen. So hat auch Brunetti keine befriedigende Bestimmungstabelle der *Conops*-Arten aufstellen können, was wohl zum Teil an der Variabilität gewisser Arten liegt.

Alle Tiere gehören in die Gruppe mit deutlichen schwarzen oder rotgelben Sammetmakeln an der Grenze von Stirn und Scheitel.

Bestimmungstafel der Conops-Arten.

1. Grosse schwarze Art mit schwarzen Fühlern und satt braunvioletten, stark irisierenden Flügeln.................... **C. philippinensis** sp. nov., Mann.
   Schwarz und rostbraun gefärbte Arten mit rostroten, oft sehr hellen Fühlern (bei *olivaceus* ist nur das erste Glied rostrot) und bleich braun tingierten Flügeln, die nur eine dunklere Vorderrandbinde oder einen dunklen Apikalfleck tragen.................... 2.
2. Flügel mit mehr oder weniger deutlichem Apikalfleck. Drittes und viertes Tergit schwarz, ohne helle Tomentbinde.
   C. nubeculosus Bigelow und Var.
   Flügel mit mehr oder weniger deutlicher Vorderrandbinde.................... 3.
3. Grosse Art mit prachtvollem Goldtoment am ganzen Körper. Hinterleib mit ausgesprochener goldgelber Bandierung am ersten bis vierten Tergit. Fühler hellrotgelb............ **C. bakeri** sp. nov., Mann und Weib.
   Kleine, dunkle Art mit kaum erkennbarem, gelblichem Reif am Hinterleib, der den Grundton desselben in ein unbestimmtes Olive verwandelt.
   C. olivaceus sp. nov., Mann und Weib.

CONOPS PHILIPPINENSIS sp. nov., Mann.

Diese Art ist sicher nahe verwandt mit *C. niponensis* Voll., vielleicht das andere Geschlecht, aber es fehlt jeglicher violette Schein und das zweite Sternit ist zum Teil rostrot. Vielleicht handelt es sich aber um ein nicht vollkommen ausgefärbtes Exemplar (die Beinfärbung spricht dafür), so dass der Schiller noch nicht zur Wirkung kommt.

Länge 19 mm; Fühler 5.2 mm; Flügellänge 1.1 mm; Flügelbreite 4.9 mm.

Samar.

Kopf rotgelb, glanzlos, nur das Untergesicht am Mundrand und der untere Augenrand sind glänzend silberweiss. Gesichtsgruben zitronengelb, glanzlos. Scheitel etwas heller gelb, mit breiter, schwarzer Mittelstrieme, mit der Breite des Fühlerhöckers beginnend, dann spatelförmig ausladend und dann wieder eingezogen bis zum glänzend schwarzen Ozellenfleck, der zwei rotbraune, glänzende Ozellen trägt. Der Augenrand ist auf kurze Strecke von einem feinen schwarzen Sammetstrich begleitet, unterhalb dessen isoliert der schwarze Tomentfleck liegt. Hinterkopf rötlich gelbbraun, an den Seiten rein kastanien braun, unten breit silberschimmernd, am Augenrand bis zur Scheitelblase linienfein silberweiss eingefasst. Untergesichtskiel schwärzlich. Rüssel etwas länger als der Kopf breit, ziemlich dick, schwarz, an der Basis rostbraun. Fühler tiefschwarz, glanzlos, das dritte Glied mit etwas rötlichem Ton, desgleichen das erste an der Unterseite. Erstes Glied ca. 3 mal so lang als breit; das zweite ca. 3 mal so lang als das erste, dicht, aber kurz schwarz behaart; das dritte so lang wie das erste, breit kegelförmig. Endgriffel 2-gliedrig, Seitenfortsatz mässig gross; das Endglied in eine starke Borste ausgezogen. Thorax schwarz, fast glanzlos, infolge Tomentierung olive erscheinend. Schulterbeulen gelbbraun, glanzlos, innen von einem feinen, gelbschimmernden Strich eingefasst, der, von hinten betrachtet, sich fleckenartig verbreitert. Schildchen und Hinterrücken oliveschwarz, letzterer oben etwas gelbgrau schimmernd. Seitenplatten gelb tomentiert. Brustseiten schwarzbraun, durch Toment olivengrünlich, ohne Schillerstrieme, nur etwas bereift. Die p erwecken den Eindruck der Unreife; sie sind gleich den Vorderhüften glanzlos gelbbraun. f oberseits schwärzlichbraun, das Spitzendrittel fast rundherum verdunkelt. Die hellen Partien etwas silbrig glänzend. t an der Spitze schwärzlich verdunkelt. Dann folgt eine auffallend hellgelbbraune Partie, dann sind sie bis zur Basis verdunkelt. t_1 innen fast ganz schwarz. Toment gelb. Alle Tarsen tiefschwarz. Haftläppchen und Klauen gelb, Spitze der letzteren schwarz. Schwinger satt ockerfarben. Hinterleib schlank, tief schwarz, fast glanzlos. Zweites Sternit etwas rostbräunlich. Hinterränder des ersten bis dritten Tergits fein weiss tomentiert, seitlich verbreitert sich das Toment. Das fünfte bis siebente Tergit stärker glänzend, mit ganz schwach bläulichem Ton. Flügel satt braun tingiert, prachtvoll irisierend, am Hinterrand kaum etwas heller.

Sehr nahe scheint auch *C. morosa* de Meijere zu stehen.

CONOPS NUBECULOSUS Bigelow, Weib, Var.

Mir scheint diese Art mit *ornatus* Big. und *fulvicornis* Kröb. einen Formenkreis zu bilden, und ich fasse die letzteren als Varietäten auf. Die Stammform hat nur eine fleckenartige Thoraxstrieme, die Varianten drei deutliche Striemen; *ornatus* hat das dritte und vierte Tergit schwarz, und die Fühlerborste weiss, t weiss tomentiert; *fulvicornis* ist nur an den Seiten des zweiten Tergits rotbraun, die t goldgelb tomentiert. Das scheinen mir höchstens lokale Rassen zu sein. Die Sammetflecken der Stirn sind für gewöhnlich tief schwarz, im vorliegenden Weib rotbraun.

Länge 13 mm; Fühler 3.5 mm; Flügellänge 10.3 mm; Flügelbreite 3.4 mm.

Surigao, Mindanao.

Stirn und Scheitel rein hellrotbraun mit mehreren concentrischen Furchen. An der Grenze liegt ein wenig auffälliger rotbrauner, nicht schwarzer Sammetfleck. Untergesicht und Backen satt ockergelb mit glänzenden Toment, nur die Gesichtsgruben sind weissgelb, lackiert, ohne Goldtoment. Rüssel rostbraun mit schwarzer Basis und schwarzbraunen Lippen. Fühler hellrotgelb. Das erste Glied 4 mal so lang als breit, kurz, spärlich, schwarz beborstet. Das zweite Glied ca. doppelt so lang als das erste, etwas dichter kurz schwarz beborstet, daher etwas dunkler erscheinend. Das dritte Glied von der Länge des ersten, heller erscheinend. Endgriffel deutlich 3-gliedrig, weiss schimmernd; das zweite Glied mit kleinem Seitenfortsatz, Endglied in eine lange Borste endigend, deren Spitze schwärzlich verdunkelt ist. Scheitelblase rostbraun. Hinterkopf sonst schwarzbraun, mit starkem, weissem Glanz am Augenrand, der quer über die Scheitelblase verläuft. Thorax im Grunde dunkelrostrot mit drei schwarzen Striemen, von denen aber nur die mittlere deutlich ist. Ein gelblicher Schimmer lässt den gesamten Thorax olive erscheinen. Schulterbeulen rostrot. Brustseiten rostrot mit weisslichen Reif, ohne eigentliche Schillerstrieme. Schildchen rostrot. Hinterrücken und Seitenplatten schwarz, aber dicht gelblich tomentiert. p hell rostbraun; Spitzen der t_3 und die Tarsen schwärzlich. Beborstung der f und t spärlich, schwarz, kurz, der Tarsen dicht und schwarz, besonders an den Seiten. Haftläppchen gelb, Klauen gelb mit schwarzer Spitze. Schwinger ockergelb. Erstes Tergit schwarzbraun, gelblich tomentiert; zweites rotbraun, durch gelblichen Schimmer olive; drittes oben schwarz, an den Seiten düster braungelb, in Seitenansicht am Hinterrand etwas gelbglänzend; viertes schwarz, glanzlos, nur am Hinterrand in Seitenansicht goldgelb tomentiert; fünftes ganz goldgelb. Theka gelbbraun, die Seiten durch gelbes Toment olive, sechstes und siebentes hell rotbraun, goldgelb tomentiert. Flügel gelblich mit ganz unscharfem, schwärzlichem Apikalfleck.

CONOPS NUBECULOSUS Bigelow var. ORNATUS Bigelow, Weib.

Länge 9 mm; Fühler 2.5 mm; Flügelbreite 2.2 mm; Flügellänge 7.6 mm.

Kolambugan, Mindanao.

Gleicht der Stammform in allen Stücken, aber das Griffelendglied ist ganz hellrotgelb, weiss schimmernd. Scheitelflecke sammetschwarz. Scheitel längs den Augen linienfein weissglänzend. Toment des Hinterkopfes silberweiss. Thorax mit drei klaren, schwarzen Striemen auf rostroten Grund, weisslich tomentiert. Brustseiten rostrot, über den Mittelhüften schwärzlich. Toment weisslich, keine Schillerstrieme. Erstes und zweites Tergit rostrot, weisslich tomentiert; drittes schwarz, seitlich etwas rostbräunlich, gleich dem tiefschwarzen vierten. Ring nur bei äusserster Seitenansicht etwas weisslich bereift. Fünftes bis siebentes dicht gelblich bestäubt; sechstes und siebentes rostrot. Theka düster gelbbraun. Flügel blasser gelb tingiert mit intensiverem Apikalfleck. p wie in der Stammform.

CONOPS BAKERI sp. nov., Mann und Weib.

Vier Weiber von nordwest Panay, Surigao, Mindanao. Ein Mann von Samar.

Weib, Länge 11 bis 16 mm; Fühler 4 bis 5.5 mm; Flügellänge 10 bis 13 mm; Flügelbreite 3.5 bis 4.5.

Mann, Länge 13 mm; Fühler 5 mm; Flügellänge 10 mm; Flügelbreite 3.5 mm.

Mann, Kopf gelborange mit intensivem Goldschimmer bis zum Scheitel. Gesichtsgruben heller, lackiert. Stirn und Scheitel rein hellbraun, erstere mit concentrischen Längs- und Querfurchen. Am Augenrand tritt je nach der Beleuchtung stückweise eine haarfeine goldgelbe Linie auf. Sammetflecken klein, dem Auge nicht direktanliegend. Rüssel düster rotbraun, ziemlich stark, ca. 2 mal kopflang, an den Enden schwärzlich. Fühler hellrostbraun. Erstes Glied 4 mal länger als breit, an der Basis oben mit kleinem dunklen Fleck, der schwarz beborstet ist. Sonst trägt nur die Unterseite etliche starke schwarze

Borsten. Zweites Glied ca. 1.5 mal so lang als das erste, dunkler, dicht schwarz beborstet. Drittes Glied so lang wie das erste, breit kegelig, hellrostrot. Griffel deutlich 3-teilig, in eine Borste ausgezogen, die zur Hälfte tief schwarz ist. Hinterkopf hellbraun, unten cremefarben, mit gelblichem Schimmer, der quer über die Scheitelblase streicht. Thorax tiefschwarz, vollkommen glanzlos, mit prachtvoll sattem Goldtoment. Schulterbeulen düster gelbbraun, innen goldgelb umsäumt. Der ganze Thorax wird rundherum von dieser Goldlinie umzogen. Auf der Platte erscheinen vorn die Anfänge von drei feinen goldgelben Linien, die bis zur Quernaht reichen. Schildchen, Hinterrücken, Seitenplatten tiefschwarz, satt goldgelb tomentiert. Hinterleib schwarz, durch Toment olive erscheinend, kurz und zerstreut schwarz behaart. Erstes bis fünftes Tergit mit prachtvoller, breiter Goldbinde am Hinterrand, die zum Teil auf gelbbraunem Grund liegt. Sechstes Tergit fast ganz goldgelb, aber glanzlos; Genitalapparat gelbbraun, glanzlos. Seiten des Hinterleibes mit gelbbräunlichem Ton. Pleuren düster rotbraun und schwarz, mit sattgoldgelber, intensiv glänzender Binde. Hüften schwarz, intensiv goldgelb tomentiert. f und t hellgelbbraun, kurz zerstreut schwarz beborstet. f zart weisslich bereift, t goldgelb tomentiert. Alle Tarsen tiefschwarz. Haftläppchen ockergelb, Klauen gelb, Spitze schwarz. Schwinger hellbraun. Flügel bräunlich tingiert mit dunklerer Vorderrandstrieme, die bis r_3 reicht, dem unbewaffnetem Auge besser erkennbar als dem bewaffneten.

Weib gleicht in allen Stücken dem Mann. f mit etwas gelblichem Schimmer. Theka, sechstes und siebentes Segment gelbbraun mit mattem, gelbem Reif. Seiten der andern Segmente breiter gelbbraun gefärbt als beim Mann. Scheitelblase und Stirn beiderseits längs den Augen schwärzlich eingefasst. Unterseite der Theka tiefschwarz.

Ein Weib von Surigao mit auffallend kleinen Sammetflecken an der Stirn, die fast rotbraun erscheinen. Ein ganz unausgefärbtes Weib ist nur an der Schillerverteilung zu erkennen, da der ganze Körper gelbbraun ist ohne jede Spur von Schwarzfärbung. Nur die Tarsen sind schwarz.

CONOPS OLIVACEUS sp. nov., Mann und Weib.

Drei Männer von Surigao, Mindanao, und Samar; ein Weib von Surigao.

Mann, Länge 8.9 bis 9 mm; Fühler 3 bis 3.1 mm; Flügellänge 7 mm; Flügelbreite 2 bis 2.1.

Weib, Länge 11 mm; Fühler 4.1 mm; Flügellänge 9.7 mm; Flügelbreite 3.4 mm.

Mann, Untergesicht braungelb mit goldgelbem Schiller bis zum Sammetfleck. Gesichtsgrube weissgelb glänzend mit schwarzem Mittelfleck. Stirn und Scheitel schwarzbraun, glänzend, mit concentrischen Ringen die am Augenrand zum Teil goldgelb bestäubt sind. Augenrand sonst schmal linienfein goldgelb eingefasst. Scheitelblase etwas heller braun als der Scheitel, querherüber gleich dem schwarzen Hinterkopf breit goldgelb tomentiert. Rüssel 2 mal kopflang; Basalhälfte dick, schwarz, glänzend, der Rest rostbraun mit schwarzen Lippen. Erstes Fühlerglied hellrotgelb mit weissem Reif, ca. 5 mal so lang als breit, sehr lang und schmal erscheinend; zweites kaum 2 mal so lang als das erste, dunkelbraun, durch Behaarung schwarz erscheinend, weisslich bereift; drittes breit kegelförmig, düster rotbraun, mit weissem Reif, trotzdem schwarzgrau erscheinend; so lang wie das erste. Endgriffel deutlich 3-gliedrig, dunkel erscheinend, in einer kurzen, starken Borste endend. Thorax schwarz, von vorn gesehen, mit gelbgrauem Reif übergossen. Schulterbeulen breit gelblich bereift. Schildchen, Hinterrücken, und Seitenplatten schwarz, mit glanzlosem, gelbem Reif. Brustseiten schwarz mit unscharfer, gelber, ziemlich glanzloser Strieme. Schwinger gelb bis dunkel gelbbraun. p und Hüften gelbbraun. Hüften glänzend gelb tomentiert. f braun, weiss bereift. Schenkelringe rotgelb, hell. t hell gelbbraun, an der Basis fast weisslich, dicht gelblich tomentiert. Tarsen schwarz. Haftläppchen gelb, Klauen gelb, Spitze schwarz. Flügel graubräunlich tingiert; die Vorderrandbinde lässt die erste Basalzelle hell, füllt die erste Hinterrandzelle ganz aus. Sie ist fast schwarzbraun. Hinterleib schwarz, ziemlich glanzlos. Zweiter Ring gelbbraun mit schwärzlicher Mitte. Dritter an den Seiten gelbbraun. Zweiter und dritter etwas glänzend. Keine hellen Binden oder Hinterränder. Toment der letzten Ringe glanzlos gelb tomentiert. Durch den gelblichen Reif sieht das ganze Tier olive aus.

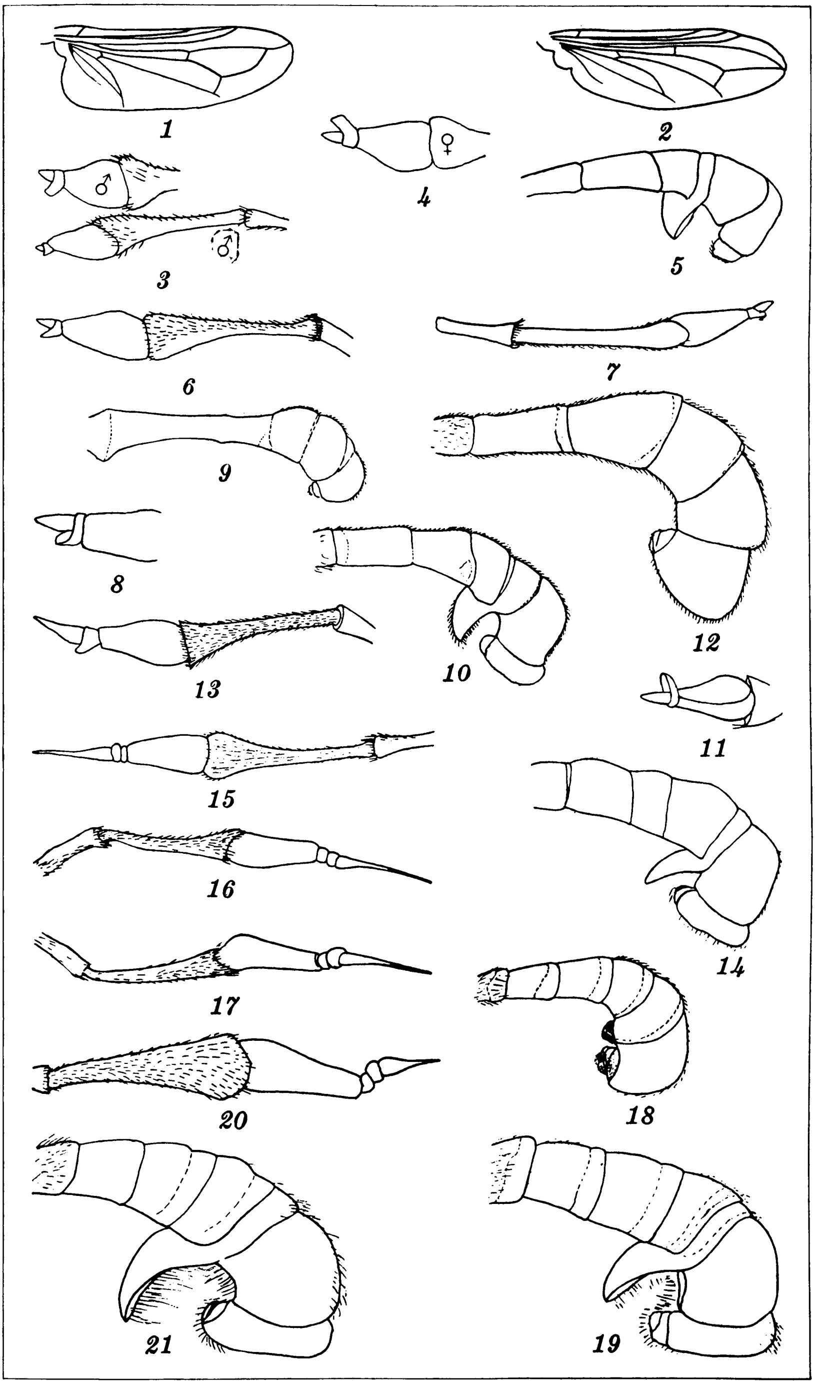
Ein Mann mit ausgedehnterer Rotgelbfärbung, die auch am dritten Ring am Hinterleib fast bis zur Mitte hinaufsteigt. Die Type ist am zweiten and dritten gelbbraun mit unscharf begrenztem, dunklem Mittelfleck. f unten an der Spitze mit gelbbraunem Längsfleck.

Weib gleicht dem Mann. Stirn bis fast zur Mitte hinauf hell gelbbraun. Untergesichtsgruben mit kleinem, schwärzlichem Fleck. Drittes Fühlerglied länger als das erste, schlanker als beim Mann. Hinterkopf heller braun. Brustseiten düster rotbraun. Hinterleib wie bei dem hellsten Mann (Type), düster gelbbraun mit verdunkelter Mitte des dritten und vierten Segments. Fünftes bis siebentes noch etwas dunkler gelbbraun, an den Seiten heller werdend. Analsegment und die gelbbraune Theka stark glänzend. Theka gross, weiter vorstehend als das Analsegment, unterseits schwarz. Hinterleib durch sehr zartes, zerstreutes, gelbes Toment ebenso olive im Ton wie beim Mann. Grundton der Flügel mehr gelbbraun, daher im ganzen heller erscheinend. Schwinger dunkelgelbbraun mit hellem Stiel.

TAFELERKLÄRUNG

TAFEL 1

FIG. 1. *Physocephala* Schiner. Flügel.
2. *Conops* Linnæus. Flügel.
3. *Physocephala limbipennis* de Meijere. Fühler und Fühlerende des Mannes.
4. *Physocephala limbipennis* de Meijere. Fühlerende des Weibes.
5. *Physocephala limbipennis* de Meijere, Weib. Abdomen.
6. *Physocephala bipartita* Doleschall, Mann. Fühler.
7. *Physocephala philippinensis* sp. nov., Mann. Fühler.
8. *Physocephala philippinensis* sp. nov., Mann. Fühlerendglied mit Griffel.
9. *Physocephala philippinensis* sp. nov., Mann. Abdomen.
10. *Physocephala philippinensis* sp. nov., Weib. Abdomen.
11. *Physocephala philippinensis* sp. nov., Weib. Fühlerendglied mit Griffel.
12. *Conops philippinensis* sp. nov., Mann. Abdomen.
13. *Conops philippinensis* sp. nov., Mann. Fühler von oben.
14. *Conops nubeculosus* Bigelow var. *ornatus* Bigelow, Weib. Abdomen.
15. *Conops nubeculosus* Bigelow var. *ornatus* Bigelow, Weib. Fühler.
16. *Conops bakeri* sp. nov., Mann. Fühler.
17. *Conops bakeri* sp. nov., Weib. Fühler.
18. *Conops bakeri* sp. nov., Mann. Abdomen.
19. *Conops bakeri* sp. nov., Weib. Abdomen.
20. *Conops olivaceus* sp. nov., Mann. Fühler.
21. *Conops olivaceus* sp. nov., Weib., Abdomen.



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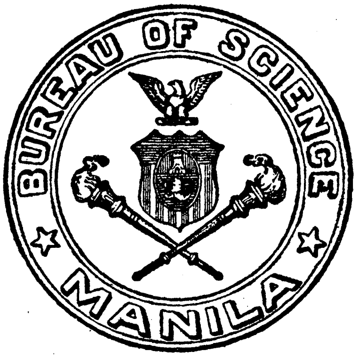

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NEW STEPHANIDÆ FROM BORNEO AND THE PHILIPPINE ISLANDS, III

By E. A. ELLIOTT

Fellow of the Zoological Society of London and of the Entomological Society of London

Subfamily DIASTEPHANUS

This subfamily shows the lowest form of development of the neuration. The group in which the anterior frontal tubercle is wanting and that in which the two femoral teeth are white appear to be closely related, differing chiefly in the proportions of the basal antennal joints, the presence or absence of a border to the posterior margin of the head, and, in a lesser degree, in details of sculpture and color. The substitution of bristles for the usual smaller teeth or serrations at the base of the femora, behind the first large tooth, occurs in many species, but the entire substitution, between and in front of the large teeth, in only a very few species.

Key to species of Diastephanus.

20. 1. Hind femora tridentate.
11. 2. All femoral teeth white.
8. 3. With small teeth between the larger ones.
5. 4. Frons apically white, the upper border forming a W. **D. trialbatus** sp. nov.
4. 5. Head otherwise colored.
7. 6. Head black, frons ferrugineous to flavous, vertex and occiput transstriate to rugose; metapleuræ and median segment confluent.. **D. pallescens** Schletterer.

6. 7. Head rufescent, frons and cheeks flavescent; occiput centrally punctate; metapleuræ and median segment separated by a carina.......... **D. multicolor** sp. nov.
3. 8. Small teeth between larger ones replaced by bristles.
10. 9. Head red-brown, part yellow; red spot on second tergite; hind metatarsi white .... **D. flavifrons** Kieffer.
9. 10. Head black, part white, white spot on second tergite; hind metatarsi rufous.......... **D. leucostictus** Kieffer.
2. 11. Hind femoral teeth not all white.
13. 12. Two apical teeth white, the basal brown or black. **D. annulipes** sp. nov.
12. 13. All femoral teeth concolorous with femora.
15. 14. Occiput and neck very short.......... **D. curticollis** sp. nov.
14. 15. Occiput and neck more or less elongate.
17. 16. Hind coxæ cylindrical; frons, vertex, and occiput finely and evenly transstriate.......... **D. lucifer** sp. nov.
16. 17. Hind coxæ clavate.
19. 18. Frons granulate rugose, mesonotum transrugose, second abdominal segment not elongate.......... **D. elongatus** sp. nov.
18. 19. Frons coarsely arcuate striate, mesonotum nearly smooth; second abdominal segment much elongate.......... **D. longior** sp. nov.
1. 20. Hind femora bidentate.
32. 21. Femoral teeth white.
25. 22. Anterior frontal tubercle present.
24. 23. Hind coxæ normal.
23b. 23a. Terebra longer than body, white-banded.......... **D. levis** sp. nov.
23a. 23b. Terebra as long as body, black.......... **D. punctinotum** sp. nov.
23. 24. Hind coxæ strongly clavate; terebra shorter than body, rufescent. **D. clavicoxis** sp. nov.
22. 25. Anterior frontal tubercle obsolete.
29. 26. Posterior margin of head bordered.
28. 27. Frons arcuate striate, vertex and occiput rugose; third flagellar joint much longer than first and second together; petiole shorter than rest of abdomen.......... **D. albidens** Kieffer.
27. 28. Frons and occiput finely, vertex coarsely transstriate; antennæ normal; petiole as long as rest of abdomen. **D. albonotatus** Elliott.
26. 29. Posterior margin of head not bordered.
31. 30. White or flavous spot on third abdominal segment. **D. flavonotatus** Elliott.
30. 31. No spot on third segment.......... **D. leucodontus** Schletterer.
21. 32. Hind femoral teeth concolorous with femora.
36. 33. Frons, vertex, and occiput finely transstriate.
35. 34. Posterior margin of head bordered; terebra rufescent. **D. parvulus** sp. nov.
34. 35. Posterior margin of head simple; terebra white-banded. **D. semiglaber** sp. nov.
33. 36. Head differently sculptured.
33. 37. Frons, vertex, and occiput arcuate striate; mesonotum with three longitudinal impressions; hind coxæ strongly clavate. **D. clavatus** sp. nov.

37. 38. Frons arcuate costate, vertex and occiput finely transstriate; mesonotum without the usual impressions; coxæ normal. **D. costifrons** sp. nov.

DIASTEPHANUS TRIALBATUS sp. nov., female and male.

Male.—Frons apically transstriate, basally more granulately, with a few punctures, posterior tubercles distinct, four carinæ on vertex, behind which it is finely transstriate, then superficially punctate, occiput basally smooth, posterior margin of head strongly bordered; scape as long as cheeks and, like the first flagellar joint, stout, second joint scarcely longer than first, third nearly as long as first and second together; pronotum finely transstriate, becoming gradually finer toward the smooth base; mesonotum with three rows of punctures very close together, lateral angles feebly rugose; scutellum centrally smooth, lateral lobes indistinctly sculptured and dull; mesopleuræ smooth; metapleuræ coarsely punctate, separated apically only by a more or less distinct carina from the median segment, which is centrally superficially and diffusely, apically and laterally more closely punctate and dull; petiole transstriate, shorter than the remaining smooth shining segments. Hind coxæ transstriate, femora extremely finely transaciculate, tridentate, tibiæ compressed in basal two-thirds, metatarsi scarcely longer than the remaining joints. Radius emitted from apical fifth of stigma, its distal section twice as long as the proximal.

Black; head beneath, cheeks, outer orbits, and frons to about the level of the middle of the eyes white, above this the frons is black, the junction of the two colors forming a distinct W; apices of tubercles and the carinæ on vertex bright red, rest of head black; two or three antennal joints and the anterior legs rufotestaceous, apices of hind coxæ and femora, a spot on each side of second tergite, the femoral teeth and hind metatarsi white; nervures red-brown.

Female.—Agrees in sculpture with the male, but the frons is apically flavous, passing into reddish, and the black color does not come down quite as low and is less sharply demarcated. Terebra rufescent, shorter than body.

Length, male, 7 to 8.5 millimeters; abdomen, 4.5 to 5; petiole, 2. Female, 9.5 millimeters; abdomen, 5.5; petiole, 2.5; terebra, 8.

BORNEO, Sandakan (*Baker*).

This species belongs to the small group with three white femoral teeth. The sculpture of the head and median segment is distinctive, as is also the striking marking of the frons, in which it resembles my *D. albifrons* which, however, has bidentate femora with concolorous teeth.

DIASTEPHANUS PALLESCENS Schletterer, female and male.

Diastephanus pallescens SCHLETTERER, Berl. Ent. Zeit. 33 (1889) 123, female.

Male.—Frons finely, indistinctly transrugose, occiput coarsely granulate rugose; posterior tubercles broad, posterior margin of head bordered; scape slightly longer than cheeks, antennæ about normal; neck elongate, finely transstriate, semiannular basally smooth; mesonotum irregularly rugose, central line of punctures distinct; scutellum centrally dull, lateral lobes lightly punctate; mesopleuræ smooth; metapleuræ and median segment indistinctly separated, reticulate punctate, former more coarsely; petiole transstriate, shorter than rest of abdomen. Hind coxæ transstriate, femora finely transaciculate, rather dull, tibiæ longer than femora, compressed in basal two-thirds, metatarsi about as long as the remaining joints. Radius emitted from near apex of stigma, its distal section about twice as long as the proximal.

Black; mandibles except apices, head beneath, frons, and scape flavescent, remainder of head red; flagellum basally rufescent, becoming black toward apex; anterior legs and hind trochanters rufescent; middle metatarsi basally and hind ones entirely whitish; femoral teeth white. All nervures rufescent.

Length, 10 millimeters; abdomen, 6.5; petiole, 3.5.

BORNEO, Sandakan (*Baker*).

I have little doubt that this is the male of Schletterer's *D. pallescens*. The sculpture is somewhat finer, but agrees in all essentials.

DIASTEPHANUS MULTICOLOR sp. nov., male.

Male.—Frons elongate, subgranulately, vertex and occiput evenly transstriate, latter centrally with large superficial punctures and longitudinal impression, posterior margin of head bordered finely, posterior tubercles broad, three carinæ behind posterior ocelli; scape as long as cheeks, antennæ normal; pronotum finely transaciculate, basally narrowly smooth, neck elongate, basal half longitudinally impressed; mesonotum centrally smooth, laterally slightly rugose, central row of punctures distinct, lateral ones basally only; scutellum centrally smooth, lateral lobes lightly punctate; mesopleuræ smooth, basally transaciculate, metapleuræ diffusely punctate above, laterally rugose, separated by a carina and a crenulate sulcus from the reticulate punctate median segment; petiole transstriate, shorter than the remaining smooth shining segments. Hind coxæ transstriate, femora and tibiæ transaciculate, the former tridentate, latter compressed in basal two-thirds, metatarsi not much longer than the remaining joints. Radius emitted from apical fourth of stigma, its distal section one and a half times as long as the proximal.

Black; base of mandibles, frons, cheeks, and head beneath flavescent, rest of head rufescent; pronotum centrally longitudinally black, laterally red, rufotestaceous beneath; petiole apically, second and third segments basally, and the hind legs rufescent, anterior legs light red, middle and hind metatarsi yellowish; femoral teeth distinctly white on one leg, more rufescent on the other.

Length, 10 millimeters; abdomen, 6; petiole, 2.5.

BORNEO, Sandakan (*Baker*).

DIASTEPHANUS FLAVIFRONS Kieffer, female and male.

Diastephanus flavifrons KIEFFER, Philip. Journ. Sci. § D 11 (1916) 408, male.

Kieffer knew only the male, and I only tentatively place here one female. It agrees well with the description of the male; the median segment may be somewhat more punctate; the terebra is shorter than the body, rufescent, and the spot on third tergite obsolete.

A male from Sandakan and one from Butuan differ in having the head light red and the pale marks on abdomen barely perceptible.

Length, male, 6 to 8 millimeters. Female, 7.5 millimeters; abdomen, 5; petiole, 2; terebra, 7.

BORNEO, Sandakan. MINDANAO, Butuan (*Baker*).

DIASTEPHANUS LEUCOSTICTUS Kieffer, female and male.

Diastephanus leucostictus KIEFFER, Philip. Journ. Sci. § D 11 (1916) 409, female and male.

These specimens agree with Kieffer's description in sculpture and in the general color; the white on the head is often more restricted, the vertex sometimes nigrescent, and the anterior femora rarely dorsally darker. This and the preceding species have the usual small denticulations between the large teeth on hind femora replaced by bristles and are very much alike; the chief differences appear to lie in the proportions of the basal antennal joints, the point of emission of the radius, and in the color.

BORNEO, Sandakan (*Baker*).

DIASTEPHANUS ANNULIPES sp. nov., female.

Female.—Frons basally arcuately, apically transversely striate, vertex and occiput finely transstriate, latter basally smooth with fine longitudinal impression, three carinæ on vertex, posterior tubercles distinct, ocellar space finely striate, posterior margin of head bordered; scape as long as cheeks, antennæ normal; neck elongate, finely transstriate, basally almost smooth, semiannular apically transstriate, basally broadly smooth; mesonotum rugose, with three fine, feebly punctate impressions; scutellum smooth; mesopleuræ smooth above, otherwise feebly punctate; metapleuræ and median segment confluent, rather irregularly reticulate punctate; petiole transstriate, very little shorter than the remaining smooth, shining segments; terebra shorter than body, black. Hind coxæ transstriate, subclavate, rather longer than the finely transaciculate, tridentate femora, tibiæ smooth, shining, compressed to middle, metatarsi half as long again as the remaining joints. Radius emitted from apical fifth of stigma, its distal section half as long again as the proximal.

Black; head and two or three basal antennal joints red, anterior legs rufotestaceous, middle tibiæ and metatarsi basally white-ringed, hind tarsi rufescent; the two basal femoral teeth white, the apical black or red. Wings hyaline, nervures and stigma red-brown.

Length, 11 millimeters; abdomen, 6.5; petiole, 3; terebra, 9.

SINGAPORE. BORNEO, Sandakan (*Baker*).

Distinguished by the peculiar color of the femoral teeth and by the sculpture of the head.

DIASTEPHANUS CURTICOLLIS sp. nov., female.

Female.—Frons finely transstriate, vertex and the very short occiput subgranulately transstriate, two inconspicuous carinæ between the posterior ocelli, posterior margin of head simple, posterior tubercles distinct; scape shorter than cheeks, antennæ normal; pronotum short and smooth, neck barely half as long as the semiannular; mesonotum centrally smooth, with three fine longitudinal impressions, laterally slightly rugose; meso- and metapleuræ smooth, latter apically punctate, separated by an incomplete carina from the median segment, which is centrally longitudinally punctate, otherwise smooth and rather dull; petiole finely transstriate, very little shorter than the remaining smooth shining segments; terebra longer than body, rufescent. Hind coxæ coarsely transrugose, about as long as the smooth, inflated, tridentate femora, tibiæ longer than the femora, compressed in basal two-thirds, metatarsi twice as long as the remaining joints. Radius emitted from apical third of stigma, its basal section three times as long as the proximal.

Black; frons and three or four basal antennal joints rufotestaceous, outer orbits whitish, vertex and occiput black, the carinæ red; legs except coxæ rufescent, middle tibiæ basally and apically white, front metatarsi, middle and hind tarsi except apex flavous. Stigma and nervures rufescent; femoral teeth concolorous with femora.

Length, 7 millimeters; abdomen, 4.5; petiole, 2; terebra, 10.

MINDANAO, Iligan (*Baker*).

Characterized by the short occiput and pronotum, simple posterior margin of head, inflated femora, smooth metapleuræ, and by the color of the legs.

DIASTEPHANUS LUCIFER sp. nov., female.

Female.—Frons, vertex, and occiput very finely subgranulately transstriate, vertex laterally indistinctly punctate, occiput basally narrowly smooth, posterior margin of head bordered, all tubercles small and rounded, carinæ on vertex indistinct; scape as long as cheeks, basal flagellar joints short, second little longer than first, third shorter than first and second together; neck rather long, pronotum finely transstriate, basally narrowly smooth; mesonotum short, slightly rugose, with a central impression only; central lobe of scutellum smooth and shining, the lateral lobes finely punctate and dull; mesopleuræ smooth and shining, metapleuræ coarsely, diffusely punctate, separated by a carina from the superficially reticulate punctate median segment; petiole extremely finely transstriate, shorter than the remaining smooth shining segments; terebra rufescent, as long as body. Hind coxæ cylindrical, basally irregularly rugose, apically transstriate, slightly longer than the finely transaciculate, tridentate femora, tibiæ longer than femora, the basal two-thirds compressed and transaciculate, metatarsi twice as long as the remaining joints. Radius emitted from near apex of stigma, its distal section half as long again as the proximal.

Black; face, frons, and four basal antennal joints testaceous, rest of head more rufotestaceous, prothorax beneath and anterior legs rufotestaceous, femora darker, middle and hind metatarsi white; nervures black. Femoral teeth concolorous with femora.

Length, 8 millimeters; abdomen, 5; petiole, 2; terebra, 8.

BORNEO, Sandakan (*Baker*).

Characterized by the sculpture of the head and hind legs, and by the cylindrical hind coxæ. The whole insect very bright, excepting lateral lobes of scutellum.

DIASTEPHANUS ELONGATUS sp. nov., male.

Male.—Frons granulate rugose, vertex and occiput finely transstriate, latter with fine longitudinal impression, posterior margin of head very finely bordered, posterior tubercles small but distinct; scape as long as cheeks, second flagellar joint fully twice as long as first, third not quite as long as first and second together; neck elongate, transstriate, semiannular basally smooth; mesonotum transrugose with central impression only indicated; scutellum centrally smooth with fine marginal punctures, lateral lobes punctate; mesopleuræ smooth; metapleuræ and median segment confluent, cribrate punctate; petiole very finely transstriate, longer than the remaining smooth segments. Hind coxæ transstriate, strongly clavate, slightly longer than the tridentate femora, trochanters elongate, tibiæ not much longer than femora, compressed to beyond middle, metatarsi scarcely longer than the remaining joints. Radius emitted from apical fourth of stigma, both sections about equal in length.

Black; head beneath, mandibles basally, face, frons apically and scape rufotestaceous, remainder of head black, basal flagellar joints rufous; legs rufescent, anterior tibiæ paler; femoral teeth concolorous with femora.

Length, 12 millimeters; abdomen, 8; petiole, 4.75.

BORNEO, Sandakan (*Baker*).

DIASTEPHANUS LONGIOR sp. nov., male.

Male.—Frons coarsely arcuate striate, vertex and occiput finely and closely transstriate, posterior margin of head bordered, ocellar space striate, two inconspicuous carinæ behind posterior ocelli, all tubercles distinct; scape fully as long as cheeks, twice as long as first flagellar joint, second twice as long as first, third as long as first and second together; neck long and slender, extremely finely transstriate, appearing almost smooth, semiannular smooth and shining; mesonotum nearly smooth, with central impression only; scutellum and mesopleuræ smooth and shining; metapleuræ and median segment confluent, cribrate punctate; petiole finely transstriate, slightly longer than the remaining smooth shining segments, abdomen elongate, especially second segment. Hind coxæ finely transstriate, apically clavate, longer than the smooth tridentate femora, tibiæ little longer than femora, compressed about to middle. Radius emitted from apical fourth of stigma, its distal section little longer than the proximal.

Black; frons apically flavous, outer orbits white, two or three basal antennal joints rufous, anterior legs rufotestaceous, femora dorsally darker, hind legs rufescent, femoral teeth concolorous with the femora.

Length, 10 millimeters; abdomen, 6.5; petiole, 3.5.

MINDANAO, Davao (*Baker*).

Resembles my *D. elongatus*, but the neck is longer and slenderer, as is also the abdomen, especially the second segment, and the sculpture of the mesonotum and shape of hind coxæ differ greatly.

DIASTEPHANUS LEVIS sp. nov., female.

Female.—Frons, vertex, and occiput finely transstriate, latter basally almost smooth, posterior margin of head bordered, two indistinct carinæ between posterior ocelli, posterior tubercles broad; scape shorter than cheeks, antennæ normal; neck elongate, finely transstriate, semiannular smooth; mesonotum short, indistinctly rugose punctate, central impression basally distinct, the lateral ones obsolete; scutellum smooth, with a few punctures; mesopleuræ smooth and shining, basally transaciculate; metapleuræ and median segment confluent, superficially and rather irregularly reticulate punctate; petiole finely transstriate, as long as the remaining smooth segments; terebra as long as body, white-banded. Hind coxæ finely transstriate, apically almost smooth, longer than the bidentate, finely transaciculate femora, tibiæ much longer than femora, compressed to beyond middle, metatarsi rather more than twice as long as the remaining joints. Radius emitted from apical fifth of stigma, its distal section one and a half times as long as the proximal.

Dark red; fourth abdominal segment black; head, three basal antennal joints, anterior legs, hind coxæ, and abdomen apically beneath rufotestaceous, hind legs darker; middle metatarsi, the second joint, and the femoral teeth white. Stigma and nervures red-brown.

Length, 10 millimeters; abdomen, 6; petiole, 3; terebra, 10; band, 1.5; apex, 0.75.

MINDANAO, Dapitan (*Baker*).

Characterized chiefly by the fine sculpture, banded terebra, and rufoflavous hind tarsi.

DIASTEPHANUS PUNCTINOTUM sp. nov., female.

Female.—Frons basally arcuately, apically transversely striate, vertex and occiput very finely transstriate, posterior margin of head bordered, all tubercles well developed, one carina between posterior ocelli; scape shorter than cheeks, inflated, second flagellar joint not much longer than first, third longer than first and second together; pronotum finely transstriate, basally narrowly smooth; mesonotum centrally coarsely, almost reticulate punctate, laterally rugose, longitudinal rows of punctures wanting; scutellum and mesopleuræ smooth, rather dull; metapleuræ and median segment confluent, reticulate punctate; petiole extremely finely transstriate, much shorter than the remaining smooth, rather dull segments; terebra about as long as body, black. Hind coxæ transstriate, femora smooth, bidentate, tibiæ little longer than femora, compressed to far beyond middle; metatarsi three times as long as the remaining joints. Radius emitted from apical fifth of stigma, its distal section one and a half times as long as the proximal.

Black; head, three or four basal antennal joints, and anterior legs rufotestaceous, front femora darker above; middle metatarsi basally whitish, hind femora and tibiæ slightly rufescent, their tarsi red; the femoral teeth white. Stigma and nervures red-brown.

MINDANAO, Zamboanga (*Baker*).

This species is especially distinguished by the sculpture of the mesonotum.

DIASTEPHANUS CLAVICOXIS sp. nov., female.

Female.—Frons, vertex, and occiput finely and evenly transstriate, latter basally smooth, ocellar space obliquely striate, no stronger carinæ behind posterior ocelli, posterior tubercles distinct, posterior margin of head bordered; pronotum smooth, neck somewhat elongate; mesonotum rugose, with central impression only, the others obsolete; scutellum smooth; mesopleuræ smooth and shining; metapleuræ and median segment confluent, rather coarsely punctate; petiole evenly transstriate, as long as the remaining shining segments, second basally slightly rugose; terebra shorter than body, rufescent. Hind coxæ clavate, finely and evenly transstriate, as long as the bidentate femora, tibiæ not much longer than femora, compressed to beyond middle, femora and tibiæ transaciculate, metatarsus rather more than twice as long as the remaining joints. Radius emitted from apical fourth of the long narrow stigma, its distal section about one and a half times as long as the proximal.

Black; head dark red, frons rufescent, anterior legs light red, hind femora nigrescent, their tibiæ rufescent; middle metatarsi basally, hind femoral teeth, and hypopygium white; hind tarsi rufescent.

Length, 12 millimeters; abdomen, 7; petiole, 3.5; terebra, 10.

MINDANAO, Kolambugan (*Baker*).

Differs from *D. levis* mainly in the shape of the hind coxæ and the rufescent terebra.

DIASTEPHANUS ALBIDENS Kieffer, female.

Diastephanus albidens KIEFFER, Philip. Journ. Sci. § D 11 (1916) 407, female.

The difference between this species and my *D. flavonotatus* appears to consist chiefly in the bordered posterior margin of head, sculpture of occiput, and proportions of basal antennal joints.

DIASTEPHANUS ALBONOTATUS Elliott.

Diastephanus albonotatus ELLIOTT, Philip. Journ. Sci. 29 (1926) 526, female.

This is another of the closely allied group, differing chiefly in the proportions of the antennal joints, posterior border of head, sculpture of the median segment, and color of the abdomen. The present species has pale markings on several segments, in addition to the conspicuous white spot on third.

Length, 7 millimeters; abdomen, 4; petiole, 2; terebra, 5; band, 0.75.

MINDANAO, Dapitan. SAMAR. PANAY, northwestern part (*Baker*).

DIASTEPHANUS FLAVONOTATUS Elliott, female and male.

Diastephanus flavonotatus ELLIOTT, Entom. 52 (1919); Proc. Zool. Soc. London (1922) 826, male; G. CABALLOS, "Eos," Revista Espagnola de Entomologia 2: 146, female and male.

The female agrees in all essentials with the male, but the median segment is more lightly sculptured; the terebra is shorter than the body, white-banded.

Female, length, 6.5 to 11 millimeters; abdomen, 4.5 to 6.5; petiole, 2 to 3; terebra, 4 to 6; band, 1 to 2. Male, length, 7.5 to 10 millimeters; abdomen, 4 to 6.5; petiole, 2 to 3.

BORNEO, Sandakan. LUZON, Mount Maquiling. MINDANAO, Iligan, Kolambugan, Dapitan, Davao. SAMAR. SIBUYAN. PANAY, northwestern part. NEGROS, Cuernos Mountains (*Baker*).

DIASTEPHANUS LEUCODONTUS Schletterer, female and male.

Diastephanus leucodontus SCHLETTERER, Berl. Ent. Zeit. 33 (1889) 121; ENDERLEIN, Zool. Anz. 33 (1905) 475; ELLIOTT, Proc. Zool. Soc. London (1922) 819, female.

Female.—Frons and vertex more or less distinctly transrugose, occiput very short, transstriate, basally more finely, anterior tubercle wanting, three costæ behind posterior ocelli, ocellar space oblique striate, posterior margin of head simple; cheeks longer than scape, second flagellar joint half as long again as first, third rather longer than first and second together; neck elongate, finely transaciculate or almost smooth, semiannular subnitidulous; mesonotum short, with central line of punctures only, laterally rugose; scutellum smooth; mesopleuræ smooth above, finely and diffusely punctate beneath; metapleuræ more or less coarsely punctate, separated by a carina from the median segment, which is centrally smooth, laterally punctate, apically more closely; petiole finely transstriate, varies from slightly shorter to slightly longer than the remaining segments—as long in the type, shorter in specimens from Sandakan, longer in some from Kolambugan—second segment basally slightly rugose; terebra shorter than body, white-banded, the proportions of the band and the black apex vary. Hind coxæ finely and evenly transstriate, as long as the smooth, bidentate femora, their tibiæ compressed in basal two-thirds, metatarsi twice as long as the remaining joints. Radius emitted from apical fifth of stigma, its distal section twice as long as the proximal.

Black; head rufotestaceous to red, vertex darker, with a black central streak, or vertex and occiput black; pronotum sometimes brownish or rufescent; anterior legs rufotestaceous, femora and apical half of tibiæ darker; middle tibiæ sometimes basally whitish, their metatarsi basally and the hind ones entirely white; hind femoral teeth white, hypopygium yellowish; in the smallest specimens the abdomen is more or less rufescent. Stigma and nervures rufescent.

Length, 7 to 11 millimeters; abdomen, 4 to 6.5; petiole, 2 to 3; terebra, 5 to 9; band, 0.5 to 2.5.

BORNEO, Sarawak (*Schletterer*); Sandakan. MINDANAO, Kolambugan (*Baker*).

Male.—The male was not known to Schletterer. It agrees structurally with the female. The neck entirely smooth, the metapleuræ and median segment more reticulate punctate. In color it agrees with the female from the same locality.

Black; head rufotestaceous, frons redder, vertex red, occiput black; pronotum red, petiole and third segment rufescent; anterior legs rufotestaceous, middle tibiæ and metatarsi whitish, hind legs rufescent, their tarsi pale.

Length, 7 millimeters; abdomen, 4; petiole, 2.

MINDANAO, Kolambugan (*Baker*).

DIASTEPHANUS PARVULUS sp. nov., female.

Female.—Frons, vertex, and occiput extremely finely transstriate, frons rather elongate, two carinæ between posterior ocelli, posterior margin of head bordered, all tubercles distinct; scape as long as cheeks, second flagellar joint little longer than first, third shorter than first and second together; neck very finely transstriate, basally narrowly smooth; mesonotum short, rugose, the longitudinal rows of punctures indistinct; scutellum and mesopleuræ smooth; metapleuræ reticulate punctate, separated by a carina from the superficially, rather irregularly punctate median segment; petiole transstriate, shorter than the remaining smooth shining segments; terebra shorter than body, rufescent. Hind coxæ transstriate, as long as the smooth, bidentate femora, tibiæ as long as the femora and trochanters together, compressed slightly beyond middle, metatarsi twice as long as the remaining joints. Radius emitted from near apex of stigma, its distal section twice as long as the proximal.

Black; head and three basal antennal joints, pronotum beneath rufotestaceous, outer orbits flavescent, occiput, pronotum above, and abdomen from second segment more or less rufescent; anterior legs rufotestaceous, middle metatarsi basally and hind ones entirely white; femoral teeth concolorous with femora. Wings strongly iridescent, stigma and nervures red-brown.

Length, 6.5 millimeters; abdomen, 4; petiole, 1.5; terebra, 5.5.

BORNEO, Sandakan (*Baker*).

The whole sculpture is extremely fine.

DIASTEPHANUS SEMIGLABER sp. nov., female.

Female.—Frons, vertex, and occiput extremely finely transstriate, posterior margin of head not bordered, two carinæ between posterior ocelli, posterior tubercles subobsolete, ocellar space oblique striate; scape slightly longer than cheeks, antennæ normal; neck elongate and slender, apically foveate, then feebly transstriate, remainder of pronotum smooth and shining; mesonotum extremely short, apically punctate, scutellum smooth; mesopleuræ large, smooth, shining, very lightly punctate beneath; metapleuræ coarsely punctate, confluent with the reticulate punctate median segment; petiole very finely transstriate, as long as the remaining smooth segments; terebra slightly longer than body, white-banded. Hind coxæ very finely and evenly transstriate, as long as the bidentate, microscopically sculptured femora, tibiæ not much longer than femora, finely transaciculate, compressed to middle, metatarsi one and a half times as long as the remaining joints. Radius emitted from apical fourth of stigma, its distal section little longer than the proximal.

Rufescent; mesonotum and scutellum black; head and base of antennæ red, vertex and occiput nigrescent, anterior legs rufous, middle tibiæ and tarsi both basally white, hind legs entirely dark rufescent. Wings hyaline, stigma and nervures black-brown.

Length, 9 to 11 millimeters; abdomen, 5.5 to 7; petiole, 2.5 to 3.5; terebra, 9 to 12; band, 2 to 3; apex, 0.75.

BORNEO, Sandakan (*Baker*).

In the smaller specimen the frons more finely subtransversely shagreened, the posterior tubercles still less developed, and the general color somewhat darker.

DIASTEPHANUS CLAVATUS sp. nov., male.

Male.—Frons, vertex, and occiput finely arcuate striate, posterior margin of head bordered, two carinæ between posterior ocelli, ocellar space oblique striate, all tubercles well developed; scape as long as cheeks, antennæ normal; neck elongate, basally finely transstriate, remainder of pronotum smooth and shining; mesonotum long with a few punctures, only the central impression basally indicated; scutellum and mesopleuræ smooth and shining, metapleuræ and median segment confluent, cribrate punctate; petiole very finely transstriate, longer than the remaining smooth segments. Hind coxæ apically very strongly clavate, basally transstriate, apically transaciculate, longer than the bidentate femora, which are dull and transaciculate, as are also the tibiæ, which are compressed in basal two-thirds, metatarsi slightly longer than the remaining joints. Radius emitted from apical fifth of the long, narrow stigma, its distal section twice as long as the proximal.

Black; head rufescent, frons apically, outer orbits, scape, and first flagellar joint flavescent; hind legs rufescent, anterior legs lighter, middle metatarsi basally white; femoral teeth red.

Length, 7.5 to 9 millimeters; abdomen, 4.5 to 5.5; petiole, 2.5 to 3.

MINDANAO, Kolambugan. BORNEO, Sandakan (*Baker*).

These specimens bear a strong resemblance to my *D. clavicoxis*. The hind coxæ are even more strongly clavate, the petiole and the distal section of radius are proportionally longer but, above all, the femoral teeth are concolorous with the femora, which makes it impossible to unite the species, as such difference between the sexes is not known to exist.

DIASTEPHANUS COSTIFRONS sp. nov., female.

Female.—The frons is costate rather than striate; the inner costæ extend into the ocellar space on each side of the ocellus, the others follow the lower curve, ending against the eyes; vertex and occiput finely transstriate, posterior margin of head extremely finely bordered, one strong carina between posterior ocelli, posterior tubercles small, broad, and inconspicuous; scape as long as cheeks, antennæ normal; neck somewhat elongate, evenly transstriate, as is also the apical half of the semiannular; mesonotum irregularly rugose, no trace of the usual longitudinal impressions; central lobe of scutellum smooth and shining, the lateral lobes dull, with microscopic sculpture; mesopleuræ smooth and shining, metapleuræ coarsely punctate, confluent with the reticulate punctate median segment; petiole finely transstriate, as long as the remaining smooth, rather dull segments; terebra rufescent, shorter than body. Hind coxæ transstriate, subclavate, about as long as the smooth bidentate femora, tibiæ longer than femora, compressed to beyond middle, metatarsi three times as long as the remaining joints. Radius emitted from apical fifth of stigma, its distal section twice as long as the proximal.

Black; head rufotestaceous, vertex and occiput red, legs rufescent, middle tibiæ and metatarsi basally white, hind tarsi red.

Length, 10 millimeters; abdomen, 6; petiole, 3; terebra, 8.

BORNEO, Sandakan (*Baker*).

The structure of the frons appears to be unique, and contrasts strongly with the fine striation of the vertex and occiput.

NEW MUSCOIDEA FROM THE PHILIPPINES REGION

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This paper presents some of the results of a study of material sent me by the late Prof. Charles F. Baker.

Genus UROEUANTHA novum

Genotype, *Uroeuantha longipes* sp. nov., Kolambugan, Mindanao.

Differs from *Minthomyia* as follows: Frontal profile at least $1\frac{1}{3}$ times facial profile; clypeus nearly flush, depressed next facialia, subequilateral, length of clypeus nearly 3 times clypeal width; palpi short, stout-cylindric, bowed, not thickened at tip in male; base of antennæ rather below eye middle; male width of vertex hardly over $\frac{1}{11}$ head width, front equilateral on hind $\frac{2}{3}$ and then widening to $\frac{1}{5}$ head width at base of antennæ; 2 hairlike verticals in male, inner verticals convergent; no reclinate frontoörbitals in male; frontalia in male linelike, visible only on forward half, parafrontalia approximated over frontalia and meeting on posterior half; 3 pairs proclinate ocellars, curved, not divaricate; parafacialia narrow, nearly equilateral, not quite as wide as facialia reversed; cheeks hardly over $\frac{1}{10}$ eye length; 1 sternopleural, 3 postsutural dorsocentrals, 3 preacrostichals but only middle one strong, no postacrostichals, 2 lateral scutellars, apical pair of scutellar bristles decussate and shorter than basal lateral scutellars, no discal scutellars; 1 bristle at base of fifth radial or third vein; fifth radial or apical cell widely open well before wing tip; third medial or hind cross vein nearer cubitulus and nearly its length therefrom, long; male front legs and hind legs extraordinarily long, very slender, tarsi extremely elongate (middle legs missing); front metatarsi equal to front tibiæ, hind metatarsi equal to next joint of tarsi; male fourth apparent or fifth actual abdominal segment caudate, tail as long as rest of segment; scattered long discal and terminal bristles below and on sides and tip of fourth apparent or fifth actual abdominal segment, but only short bristles above like hairs of rest of abdomen.

UROEUANTHA LONGIPES sp. nov.

Length of body, 12 millimeters; length of wing, 11; 1 male, Kolambugan, Mindanao, No. 23236 (*Baker*).

Head silvery, frontalia brown, palpi very pale testaceous; plr silvery, mesoscutum silvery with a faint yellowish tinge; 4 black thoracic vittæ, inner pair of thoracic vittæ linelike before transverse suture but lost behind transverse suture in wide median black area that does not reach hind margin of postscutum and narrows some posteriorly; scutellum blackish brown, silvery on tip; abdomen yellow, with extreme base above, median vitta above and below, hind edge of second apparent or third actual abdominal segment and all of last 2 abdominal segments except front fourth of third apparent or fourth actual abdominal segment brownish black, basal fourth of last 2 abdominal segments silvery; legs dark brown, coxæ silvery; wings faintly yellowish smoky, costa stigma to wing tip slightly more marked; squamæ translucent, with straw-colored edge.

Genus URODEXIOMIMA novum

Genotype, *Urodexiomima uramyoides* sp. nov., Los Baños.

Differs from *Pseudodexia* as follows: Frontal profile rather flattened, but little arcuate, 1½ times facial profile; clypeus nearly flush, narrow, length of clypeus over twice clypeal width; facialia bare, flattened-cordlike; vibrissal axis some less than antennal axis, latter quite ¾ head height; palpi long, slender, subcylindric, scarcely thickened at tip in male, a little thicker on distal third; base of antennæ rather below eye middle; male, third antennal joint 3 times second antennal joint, narrow, rounded at tip; arista short, scarcely longer than third antennal joint, thinly long-plumose to tip; male, width of vertex ⅕ head width, front equilateral on hind half and then widening to ⅓ head width at base of antennæ; verticals 1 in male; parafacialia bare, strongly narrowed below, as wide above as clypeal width; cheeks probably about ⅓ eye length (shrunken) ; 2 postintraalars and postacrostichals, 2 long lateral scutellars, long decussate apical scutellars, 1 moderately strong discal scutellar; first radial or first vein terminating very far beyond sixth radial or small cross vein, with 1 bristle at tip on one side; fifth radial or apical cell narrowly open moderately before wing tip; third medial or hind cross vein sinuate, ¾ its length from cubitulus; squamæ rather large, strongly widened behind, the subangular inner hind corner of squamæ produced inward; 1 median marginal on first apparent or second actual abdominal segment.

URODEXIOMIMA URAMYOIDES sp. nov.

Length of body, 8.5 millimeters; length of wing, 7.5; 1 male, Los Baños, Luzon (*Baker*).

Head tawny silvery; frontalia and antennæ reddish fulvous, third antennal joint largely brown; palpi fulvous; plr and mesoscutum grayish silvery; 4 thoracic vittæ, outer pair of thoracic vittæ very broad and interrupted at transverse suture, inner pair of thoracic vittæ narrow before transverse suture, all 4 subconfluent behind transverse suture in a large rich brown subrectangular marking showing some golden pollen; scutellum brown on base, pollinose on tip and hind margin; abdomen fulvous yellow, with median vitta, basal or first actual abdominal segment, hind third of first apparent or second actual abdominal segment, hind $\frac{2}{5}$ second apparent or third actual abdominal segment, hind half of third apparent or fourth actual abdominal segment, and angular tip of fourth apparent or fifth actual abdominal segment brown; bases of intermediate segments narrowly silvery, nearly basal $\frac{3}{4}$ of fourth apparent or fifth actual abdominal segment silvery; coxæ and femora fulvous, tibiæ little darker, tarsi blackish; wings nearly clear, squamæ glassy whitish.

Genus SISYROPODODEXIA novum

Genotype, *Sisyropododexia luteicornis* sp. nov., Mindanao.

Differs from *Spathidexia* as follows: Palpi length of haustellum, bowed, wide throughout; male third antennal joint 3 times second antennal joint, narrow, equilateral, rounded at tip; arista longer than antennæ, short-plumose halfway; eyes very large and long, not oblique, reaching far below oral margin level; male verticals $\frac{1}{5}$ head width, front only faintly widening to less than $\frac{1}{3}$ head width at base of antennæ; frontals stopping at base of antennæ, 4 or 5 in number; 2 verticals in male; 3 proclinate frontoörbitals in male, set in middle of width and on hind half of length of parafrontalia; 1 reclinate frontoörbital in male, set inside and in advance of hind proclinate frontoörbitals; cheeks about $\frac{1}{15}$ eye length; 2 postintraalars and preacrostichals; no costal spine; fifth radial or third vein bristled $\frac{1}{3}$ to halfway to sixth radial or small cross vein; fifth radial or apical cell open a little before wing tip; third medial or hind cross vein sinuate, not its length from cubitulus; all metatarsi exceeding following joints.

SISYROPODODEXIA LUTEICORNIS sp. nov.

Length of body, 10 to 11 millimeters; length of wing, 9; 3 males, Surigao and Dapitan, Mindanao, and Sibuyan (*Baker*).

Yellowish ground color; head silvery white; vertex and parafrontalia golden on inner edge and above; frontalia dark brown, antennæ bright yellow, palpi pale straw color; plr silvery, mesoscutum golden; 4 blackish thoracic vittæ, inner pair of thoracic vittæ narrow; scutellum pale yellowish or fulvous, light golden pollinose; abdomen fulvous yellow, with basal depression, median vitta and hind borders last 2 abdominal segments blackish; narrow base first 2 abdominal segments and basal half of fourth apparent or fifth actual abdominal segment silvery; legs yellow, tarsi and hind tibiæ black; wings yellowish on costa and wing veins; squamæ yellowish.

Genus PHILIPPOFORMOSIA novum

Genotype, *Philippoformosia splendida* sp. nov., Nueva Vizcaya.

Differs from *Tutilodexia* as follows: Facial carina not canaliculate on median line; arista micropubescent; parafacialia hairy; cheeks fully $\frac{3}{4}$ eye length; fifth radial or apical cell widely open considerably before wing tip; hind tibiæ short-ciliate; fourth apparent or fifth actual abdominal segment with marginal row hairlike and longer than marginal row of third apparent or fourth actual abdominal segment.

PHILIPPOFORMOSIA SPLENDIDA sp. nov.

Length of body, 13 millimeters; length of wing, 14; 1 female, Imugan, Nueva Vizcaya (*Baker*).

Head metallic bluish green, frontalia dark brown; antennæ, clypeus, epistoma, facialia, palpi, and cheek grooves brownish testaceous; plr blackish green; mesoscutum bright green, with golden reflections; 4 violet cupreous thoracic vittæ, inner pair of thoracic vittæ black and narrow before transverse suture, all violaceous and subconfluent behind transverse suture, scutellum cupreous violet, narrow margin blackish green; abdomen golden green with some bright cupreous reflections; first apparent or second actual abdominal segment, median line and hind half of intermediate segments dark chocolate brown, venter showing green on front parts of first apparent or second actual abdominal segment; legs blackish; wings lightly tinged with yellowish smoky, darker on wing veins, blackish on basal cells and first subcostal or humeral cross vein; squamæ pale smoky brown.

Genus EPSEUDOCYPTERA novum

Genotype, *Epseudocyptera epalpata* sp. nov., Mindanao.

Differs from Brauer and Bergenstamm's description of *Pseudocyptera* as follows: Palpi absent; female width of vertex ¼ head width, front widening to fully ⅖ head width at base of antennæ; wings nearly clear; abdomen very long-oval, wider end forward; 2 sternopleurals, being the front ones, hind absent; 3 postsutural dorsocentrals, 2 postintraalars, 3 very short preacrostichals; 3 postracrostichals, 2 front ones short; 2 lateral scutellars, strong decussate apical pair of scutellar bristles, 1 very small hairlike discal scutellar; cheeks nearly ⅓ eye length; epistoma cut off just above vibrissal level, full width, strongly and suddenly warped; frontals 5, stopping at front edge of base of antennæ.

EPSEUDOCYPTERA EPALPATA sp. nov.

Length of body, 10 millimeters; length of wing, 7.5; 1 female, Davao, Mindanao (*Baker*).

Head silvery, frontalia brown; first antennal joint and basal half of second antennal joint brown, rest of second antennal joint subrufous, third antennal joint subfulvous; plr, mesoscutum, and scutellum silvery; 4 black thoracic vittæ, inner pair of thoracic vittæ narrower; abdomen black, intermediate segments widely silvery on bases; legs black, tibiæ subfulvous on distal half; wings faintly yellowish on costa, subfulvous on wing base, faintly blackish at wing tip; squamæ watery whitish.

Genus PALPOCYPTERA novum

Genotype, *Palpocyptera pulchra* sp. nov., Mindanao.

Differs from *Ocypteropsis* as follows: Frontal profile not over ⅔ facial profile, flat, but little sloped; clypeus flush, arched on median line, length of clypeus 1½ times clypeal width; epistoma cut short, full width, well warped; vibrissal axis equal to antennal axis, latter nearly ⅗ head height; proboscis (retracted) apparently short but slender and corneous, labella rather small; female width of vertex $\frac{3}{13}$ head width, front widening gradually, face in middle little over ½ head width; 1 long strong vertical in female; frontalia gently narrowed behind, width of frontalia little over 1½ times width of parafrontal in middle in female;

parafacialia bare, narrow, long, nearly equilateral, little wider than widest part of facialia; 3 preacrostichals; 4 postacrostichals, front 2 weaker; 1 discal scutellar, shorter than the decussate apical scutellars; fifth radial or apical cell petiolate well before wing tip, stalk shorter than sixth radial or small cross vein; third medial or hind cross vein strongly sinuate, ⅔ its length from cubitulus; marginal row on third apparent or fourth actual abdominal segment.

PALPOCYPTERA PULCHRA sp. nov.

Length of body, 16.5 millimeters; length of wing, 13; 1 female, Surigao, Mindanao (*Baker*).

Shining black; head light golden pollinose, changing in oblique view to rust brown; frontalia velvety dark brown; parafrontalia shining dark brown on over hind half; palpi dark brown, tips paler; occiput gray, occipital beard pale brassy; plr, mesoscutum, and scutellum thinly silvery; 4 black thoracic vittæ, inner pair of thoracic vittæ linelike; basal third of second apparent or third actual abdominal segment and nearly basal half of third apparent or fourth actual abdominal segment deep golden pollinose; coxæ and femora pale golden pollinose on outside; tibiæ rufous except base; wings well suffused with yellow, wing veins darker; squamæ nearly concolorous, more or less glassy.

Genus OPSOCYPTERA novum

Genotype, *Opsocyptera optima* sp. nov., Mindanao.

Differs from *Ocypterula* as follows: Clypeus flush, narrow, long, equilateral, length of clypeus fully 2½ times clypeal width; epistoma full width, strongly warped, length of epistoma nearly ½ width of epistoma; vibrissal axis exceeding antennal axis, latter nearly head height; eyes bare, long, oblique, reaching rather below oral margin level and well below vibrissal level; female, width of vertex scarcely ⅓ head width, front widening gently to over ⅓ head width at base of antennæ; frontals 5 or 6, small, stopping even with frontalia and closely approximated to same; 2 proclinate frontoörbitals in female, hind one very short and weak like frontals; 1 weak reclinate frontoörbital in female; ocellars 1, weak, proclinate, and 1, weak, divaricate behind ocelli, also occipitocentrals behind latter; parafacialia bare, equilateral, width of parafacial a little less than clypeal width; cheeks ¼ eye length; 2 sternopleurals; 2 lateral scutellars, both long and equal; strong decussate apical pair of scutellar bristles, shorter than lateral scutellars; first medial or apical cross vein strongly sinuate; short stump of vein at cubitulus; female abdomen long and narrow, equilateral, length of abdomen over twice length of thorax, 5 abdominal segments seen from above but first very short; fourth apparent or fifth actual abdominal segment with marginal row of 6 but median marginal pair set so far forward as to appear discal.

OPSOCYPTERA OPTIMA sp. nov.

Length of body, 8 to 9 millimeters; length of wing, 6 to 6.75; 2 females, Dapitan and Kolambugan, Mindanao, No. 23258 (*Baker*).

Head silvery, parafrontalia faintly brassy; frontalia dark brown, antennæ blackish; plr silvery between leg grooves; mesoscutum thinly sivery, with very faint brassy tinge; 4 thoracic vittæ dark, outer pair of thoracic vittæ heavy, inner pair of thoracic vittæ very delicate and linelike; scutellum thinly silvery; abdomen rufous, with extreme base, median vitta on base, hypopygium, fourth apparent or fifth actual abdominal segment and irregular hind half of third apparent or fourth actual abdominal segment black; second apparent or third actual abdominal segment narrowly silvery on base, third apparent or fourth actual abdominal segment silvery more or less on basal two-thirds; legs black; wings yellow on broad costobasal portion, blackish on rest of wing-vein region but with light areas in fifth radial or apical cell and discal cell, wide irregular inner border nearly clear; squamæ whitish, edges narrowly tawny.

Genus ZAMBESOIDES novum

Genotype, *Zambesoides samarensis* sp. nov., Samar.

Differs from *Zambesa* as follows: Head wider than high, vertex well depressed below top level of eyes; vibrissal axis equal to antennal axis, latter $\frac{3}{4}$ head height; second antennal joint elongate, third antennal joint in female hardly 3 times second antennal joint; eyes bare, oblique, reaching nearly to vibrissal level; female width of vertex hardly over $\frac{1}{7}$ head width, front widening very gradually to scarcely $\frac{1}{4}$ head width at base of antennæ; face in middle little over $\frac{1}{3}$ head width; verticals 1 in female, decussate; 1 strong proclinate frontoörbital in female; frontalia gently narrowed behind, width of frontalia equal to width of parafrontal in middle; no preacrostichals, 1 weak postacrostichal; apical pair of scutellar bristles decussate, equal to basal lateral scutellars; sixth radial or small cross vein normal, first radial or first vein terminating opposite same; fifth radial or apical cell open twice mouth width of fifth radial or apical cell before wing tip, tip of cell elongate and narrow; cubitulus rounded obtuse angled, $\frac{1}{3}$ width of wing from hind margin of wing; first medial or apical cross vein arcuate inward; no median discals on any abdominal segments.

ZAMBESOIDES SAMARENSIS sp. nov.

Length of body, 11 millimeters; length of wing, 9; 1 female, Samar (*Baker*).

Head silvery, parafrontalia more leaden silvery; frontalia dark brown; antennæ black, third antennal joint dark brown shading to subrufous on inner proximal half; palpi blackish; plr silvery, mesoscutum more leaden silvery; 4 blackish thoracic vittæ, inner pair of thoracic vittæ delicately linelike; scutellum black, faintly silvery; abdomen black, bases of intermediate segments and all of fourth apparent or fifth actual abdominal segment silvery, ventral triangles of silvery on first apparent or second actual abdominal segment and second apparent or third actual abdominal segment, whole venter of third apparent or fourth actual abdominal segment silvery; legs blackish, proximal $\frac{3}{4}$ of femora largely pale fulvous; wings faintly smoky, slightly darker on costa from stigma to wing tip; squamæ glassy, narrow edges opaque straw color.

Genus ANDROCYPTERA novum

Genotype, *Androcyptera anorbitalis* sp. nov., Baguio.

Differs from *Ichneumonops* as follows: Clypeus flush, length of clypeus twice clypeal width; vibrissæ long, decussate, removed from oral margin at least laterally; third antennal joint $1\frac{1}{2}$ times second antennal joint, narrow, rounded at tip; width of vertex, male and female, over $\frac{1}{4}$ head width, front widening gently in female to $\frac{1}{3}$ and in male to over $\frac{1}{3}$ head width at base of antennæ; no proclinate frontoörbitals nor reclinate frontoörbitals, male and female; cheeks scarcely $\frac{1}{4}$ eye length; 1 lateral scutellar; apical pair of scutellar bristles strong, decussate, not as long as lateral scutellars; fifth radial or apical cell long-petiolate far before wing tip, stalk over twice sixth radial or small cross vein and strongly bent upward; cubitulus rounded right angled to faintly obtuse angled, $\frac{1}{3}$ width of wing from hind margin of wing; first medial or apical cross vein bent in at tip to form a V with stalk of fifth radial or apical cell, in middle faintly bent in; no wrinkle at cubitulus; abdomen bottlelike, petiolate, length of abdomen twice length of thorax in male but not in female, first apparent or second actual abdominal segment strongly widened behind; 1 median marginal on first two abdominal segments, marginal row of 6 to 8 on last 2 abdominal segments.

ANDROCYPTERA ANORBITALIS sp. nov.

Length of body, 6 to 7 millimeters; length of wing, 4.5 to 6; 2 females, Baguio, Benguet, No. 5037; 2 males, Tangcolan, Bukidnon, No. 23240 (*Baker*).

Head silvery, parafrontalia faintly golden in male; frontalia and antennæ brown, base of third antennal joint lighter in female; plr and mesoscutum silvery, 2 very broad subconfluent black thoracic vittæ; scutellum and abdomen brownish black, bases of last 3 abdominal segments silvery; legs blackish, femora and coxæ silvery; wings lightly smoky in male, more dilute in female; squamæ nearly white, faintly yellowish in female at times.

Genus ALOPHOROPHASIA novum

Genotype, *Alophorophasia alata* sp. nov., Luzon.

Differs from *Xanthosyntomogaster* as follows: Epistoma long, wide, widened some below, well sprung, length of epistoma not half the length of clypeus nor equal to upper width of epistoma, latter twice width of facialia plus width of parafacial; vibrissæ strong, well differentiated; palpi stout-cylindric, length of antennæ, scarcely thickened at tip in male; second antennal joint elongate; third antennal joint in male nearly twice second antennal joint, rather narrow, rounded at tip; eyes bare, very large, not oblique, excavated behind on lower half, reaching below oral margin level but not completely hiding cheeks; frontals 11 to 12, close to frontalia, stopping at base of antennæ; parafacialia narrow, equilateral, width of parafacial $\frac{1}{3}$ clypeal width and equal to width of facialia; cheeks $\frac{1}{12}$ eye length in male; 3 sternopleurals, no preacrostichals, 1 lateral scutellar; cubitulus strongly rounded obtuse angled, $\frac{1}{7}$ width of wing from hind margin of wing; third medial or hind cross vein sinuate, not its length from cubitulus; no median discals on any abdominal segments, macrochætæ extremely short and barely differentiated; median marginals, middle legs, and lateral discals on first apparent or second actual abdominal segment.

ALOPHOROPHASIA ALATA sp. nov.

Length of body, 10 millimeters; length of wing, 8.75; 1 male, Mount Banahao, Luzon, No. 5026 (*Baker*).

Head golden; frontalia, antennæ, and palpi blackish; occiput and cheeks silvery, occipital beard whitish; plr, 2 spots on front edge of prescutum, humeri, hind margin of prescutum and hind and lateral margins of postscutum silvery; rest of mesoscutum black, thoracic vittæ not apparent, scutellum brown to blackish; abdomen fulvous yellow, shading to dusky above and below on median line and hind half; legs deep brown, trochanters and coxæ subfulvous; wings lightly yellowish smoky; squamæ translucent, faintly smoky, squamulæ more opaque and whitish.

Genus OCHROPHASIA novum

Genotype, *Ochrophasia atripennis* sp. nov., Mindanao.

Differs from *Clytiomya* as follows: Length of epistoma half length of clypeus, width of epistoma half width of facialia plus width of parafacial, epistoma gently warped; facialia very wide, flattened, bare, slightly oblique to clypeal plane, as wide below as parafacialia, width of facialia $\frac{2}{3}$ clypeal width; no differentiated vibrissæ, only short bristles of even length; palpi equal to third antennal joint, stout-clavate, bowed; female width of vertex not $\frac{1}{5}$ head width, front widening very rapidly to $\frac{2}{5}$ head width at base of antennæ; frontalia short, broad, nearly equilateral, anterior points spread, width of frontalia fully equal to width of parafrontal in middle, length of frontalia on median line from lunula to ocellar triangle little over twice width of frontalia; width of parafacial above equals clypeal width; apical scutellars parallel, short; fifth radial or apical cell open nearly in wing tip; cubitulus a rounded widely obtuse angle, scarcely $\frac{1}{4}$ width of wing from hind margin of wing; female hypopygium small, ventrocaudal aspect, telescoped, normal, egg-depositing.

OCHROPHASIA ATRIPENNIS sp. nov.

Length of body, 11 millimeters; length of wing, 9.5; 1 female, Surigao, Mindanao (*Baker*).

Head golden, more brightly so on parafrontalia; frontalia and antennæ brown; palpi pale fulvous; uocc blackish; occipital beard brassy whitish; plr golden; mesoscutum blackish, margins fulvorufous and golden pollinose; scutellum and abdomen orange ocherous, venter paler yellow; legs orange yellow, tarsi and tibiæ blackish; wings smoky black throughout, scarcely lighter on inner edge; squamæ golden yellow.

Genus OXYDEXIOPS novum

Genotype, *Oxydexiops uramyoides* sp. nov., Mindanao.

Differs from *Meigenia* as follows: Frontal profile long, flattened in female and faintly arcuate in male, strongly sloped, scarcely longer than facial profile to end of epistoma; clypeus well depressed, narrowing gently upward, length of clypeus $2\frac{1}{2}$ times clypeal width; epistoma long, full width, in clypeal plane in male and gently warped in female, length of epistoma fully half width of epistoma; vibrissæ strong, decussate, far above oral margin level; proboscis very short, stout, haustellum equals length of labella and not $\frac{1}{4}$ head height, labella very large; palpi stout, bowed, length of haustellum, widened and flattened especially in female; base of antennæ on eye middle; arista longer than whole antennæ, thickened $\frac{1}{6}$ to $\frac{1}{7}$ way, micropubescent on little more than thickened part; width of vertex, male and female, $\frac{1}{11}$ head width, front equilateral on over hind half of female and on nearly hind half of male, then widening to $\frac{1}{5}$ head width at base of antennæ in male and somewhat less in female (head shrunken in female); 2 strong proclinate fronto-orbitals, male and female, close to frontals; width of frontalia half the width of parafrontal in middle in male, over half in female; cheeks $\frac{1}{6}$ eye length in male, $\frac{1}{7}$ in female; 2 sternopleurals, no discal scutellars; fifth radial or apical cell open well before wing tip; cubitulus rounded right angled to slightly obtuse angled, $\frac{1}{6}$ width of wing from hind margin of wing; first medial or apical cross vein well arcuate inward; squamæ rather long, well widened behind, inner hind corner of squamæ subangular, especially in male; legs long, in male middle legs longer than others; hind tibiæ short-ciliate on basal half or so, male and female, with a slightly stouter bristle near middle; female metatarsi equal following joints, middle metatarsi of female longer than following joints; male metatarsi not equal to following joints, middle metatarsi and tarsi of male very long.

OXYDEXIOPS URAMYOIDES sp. nov.

Length of body, 11 to 16 millimeters; length of wing, 9 to 10.5; 2 males, Butuan, Mindanao; 2 females, Davao, Mindanao, and Mount Banahao, Luzon, No. 23233 (*Baker*).

Head silvery, parafrontalia in male brassy on hind half; frontalia and antennæ blackish brown, second antennal joint and base of third antennal joint more or less rufous; palpi fulvous; plr silvery; mesoscutum silvery, faintly brassy; 4 blackish brown thoracic vittæ, inner pair of thoracic vittæ narrower, outer pair of thoracic vittæ semicolonlike and confluent with inner pair of thoracic vittæ behind transverse suture in rectangular brown marking pronged behind on each side; scutellum dark brown on base, silvery on apical half; abdomen pale rufofulvous, female with first apparent or second actual abdominal segment, hind borders of last 3 abdominal segments and broken median vitta dark brown; male with depression of first apparent or second actual abdominal segment, narrow median vitta, broad hind borders of intermediate segments and all of fourth apparent or fifth actual abdominal segment except extreme base brown; light parts of abdomen thinly silvery pollinose and fourth apparent or fifth actual abdominal segment in male the same; legs brown, femora fulvous except tips of middle femora and hind femora; wings in female clear, in male faintly yellowish smoky on wing veins; squamæ glassy whitish, faintly tawny yellowish in male.

Genus STRONGYLONEUROPSIS novum

Genotype, *Strongyloneuropsis malayensis* sp. nov., Singapore.

Differs from *Strongyloneura* (*S. nepalana* Tyler-Townsend) as follows: Palpi flattened laterally, thin, widened apically, bristled; arista rather thinly long-plumose to tip; male, width of vertex one-ninth head width, front narrowed before ocellar triangle and then widened to over one-fourth head width at base of antennæ; female, width of vertex fully one-fifth head width, front widening gradually to one-third head width at base of antennæ; face below about half head width; parafacialia equilateral in male, narrowed some below in female, width of parafacialia equal to width of facialia; facioörbitals represented by row of setæ; third long vein bristled one-third to halfway to small cross vein; apical cell open 3 to 4 times mouth width of fifth radial or apical cell before wing tip; cubitulus a widely rounded obtuse angle, about one-fourth wing width from hind margin of wing; male hypopygium large, caudoventral, first hypopygial segment with strong erect bristles, second hypopygial segment with weaker bristles; female hypopygium large, flattened boxlike, theca broad.

STRONGYLONEUROPSIS MALAYENSIS sp. nov.

Length of body, 8.5 millimeters; length of wing, 6.5. One male and one female, Singapore (*Baker 9152*).

Head silvery cinereous, frontalia brown, palpi and antennæ fulvous yellow; thorax and abdomen metallic green, thinly silvery white; three dark brown subequal thoracic vittæ, obsolete before transverse suture of mesoscutum in male; first apparent or second actual abdominal segment, intermediate segments of abdomen except broad front corners, median vitta and hind half or less of fourth apparent or fifth actual abdominal segment brownish black, rest of tergum green to cupreous and silvery white pollinose; legs blackish, tibiæ fainty reddish; wings yellowish on costa, except blackish cloud before wing tip; squamæ nearly white.

Genus MEDINACEMYIA novum

Genotype, *Medinacemyia sibuyana* sp. nov., Sibuyan.

Differs from *Euhalidaya* as follows: Epistoma receding below from clypeal plane, nearly as long as upper width; proboscis stublike, not over one-fourth head height, haustellum not much longer than wide, labella large; base of antennæ on eye middle, antennæ separated at base; arista thickened one-fifth way, micropubescent halfway; eyes pushed slightly forward below, reaching median oral margin level; male, width of vertex nearly one-third head width, front widening very gradually to over one-third head width at base of antennæ; face below three-sevenths head width and appearing subequilateral with front at base of antennæ; frontals stopping even with frontalia and hugging edge of same, 6 strong; no outer verticals or proclinate frontoörbitals in male, 2 reclinate frontoörbitals in male; frontalia in male nearly equilateral, width of frontalia rather over width of parafrontal in middle; parafacialia bare, equilateral but widened suddenly above, scarcely as wide as facialia below; male cheeks scarcely one-sixth eye length; sternopleurals 2, strong, haustellum much longer; postacrostichals 4; third long vein bristled halfway to small cross vein; 1 median discal on last three abdominal segments.

MEDINACEMYIA SIBUYANA sp. nov.

Length of body, 8.5 millimeters; length of wing, 7. One male, Sibuyan Island.

Head tawny silvery, parafrontalia deep golden; frontalia dark brown; antennæ and palpi rufofulvous; pleura tawny silvery; mesoscutum golden, hind edge and four thoracic vittæ blackish, latter blotchlike except inner pair of thoracic vittæ—when 4 or more are present—before transverse suture of mesoscutum, all confluent behind transverse suture of mesoscutum as seen from behind; scutellum blackish on basal fourth, rust brown on next fourth, golden on posterior half; abdomen fulvous, faint median vitta and irregular hind margins of abdominal segments brownish, basal half or so of last three abdominal segments bright golden pollinose; legs blackish; wings yellowish on costa and base; squamæ pale yellowish tawny.

Genus PROPARATHELAIRA novum

Genotype, *Proparathelaira plumosa* sp. nov., Luzon.

Differs from *Parathelaira* as follows: Frontal profile somewhat arcuate; epistoma cut off short, edge at most faintly warped, facialia straight, flattened oblique to clypeal plane; female, second antennal joint short, third antennal joint nearly four times second antennal joint and equilateral; arista thickly short-plumose halfway, then thinly shorter-plumose; female, width of vertex one-fifth head width, front gradually widening to one-third head width at base of antennæ; face only faintly widening from front; 2 verticals in female, inner verticals decussate; 2 proclinate frontoörbitals in female, stronger than frontals; 1 reclinate frontoörbital equal to frontals; 3 sternopleurals, 2 postintraalars, 1 preacrostichal, 1 postacrostichal; squamæ wide behind, inner hind corner of squamæ rather angular; metatarsi equal to following joints; no median discals on last three abdominal segments.

PROPARATHELAIRA PLUMOSA sp. nov.

Length of body, 8 millimeters; length of wing, 7. One female, Mount Maquiling, Luzon.

Head silvery white, frontalia dark brown; antennæ pale fulvous yellow; palpi pale straw yellow; thorax silvery, inner edge of parafacialia and mesoscutum along median line faintly golden; four black thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—narrow before transverse suture but coalesced behind transverse suture; abdomen translucent fulvorufous, third apparent or fourth actual abdominal segment, posterior half of second apparent or third actual abdominal segment, and median vitta blackish; last three abdominal segments narrowly silvery on base; legs fulvous yellow, tibiæ and tarsi blackish; wings lightly yellow; squamæ glassy yellow.

Genus ASBELLOPSIS novum

Genotype, *Asbellopsis luzonensis* sp. nov., Luzon.

Differs from *Sumatrodexia* as follows: Frontal profile faintly arcuate, hardly 1⅓ times facial profile; latter not receding; occipital plane in vertical; epistoma cut off at vibrissal level; facialia bare; proboscis half head height; haustellum 3 times as long as thick; female, third antennal joint 3 times second antennal joint; female, width of vertex two-fifths head width, front widening gradually to fully half head width at base of antennæ; face in middle five-sevenths head width; frontals 6 in female; 2 long proclinate frontoörbitals and 1 long divaricate reclinate frontoörbital in female; frontalia narrowed posteriorly, two-thirds width of parafrontal in middle in female; parafacialia bare, equilateral, equal to width of clypeus; no genoörbitals; 1 postacrostichal; prescutum shorter than postscutum; 4 dark thoracic vittæ; costal spine strong, longer than small cross vein; apical cell widely open hardly twice mouth width of fifth radial or apical cell before wing tip, tip curved handlelike; apical cross vein strongly bowed in; hind cross vein its length from cubitulus; squamæ rather small, a little widened behind, inner hind corner of squamæ subangular; abdomen oval in female; marginal row of 6 on second apparent or third actual abdominal segment; no median discals on fourth apparent or fifth actual abdominal segment.

ASBELLOPSIS LUZONENSIS sp. nov.

Length of body, 8.75 millimeters; length of wing, 7.75. One female, Los Baños, Luzon (*Baker 479*).

Head tawny pollinose, parafrontalia and upper occipital orbits somewhat deeper tawny; frontalia blackish brown; antennæ and palpi bright fulvous; cheek grooves reddish brown; pleura and mesoscutum cupreous to green, blue or violet in ground color, well tawny silvery pollinose; inner pair of thoracic vittæ—when 4 or more are present—narrow, outer pair of thoracic vittæ very heavy but rather even; scutellum brown, thinly pollinose; abdomen yellowish to fulvous, brown on median vitta, narrow hind margin of first apparent or second actual abdominal segment, wider hind margin of second apparent or third actual abdominal segment, nearly all of third apparent or fourth actual abdominal segment above, and sides of fourth apparent or fifth actual abdominal segment; bases of last three abdominal segments tawny silvery pollinose, more so on last two abdominal segments; legs fulvous yellowish, tibiæ more brownish, tarsi dark; wings lightly yellowish infuscate; squamæ pale tawny translucent.

Genus BARYDEXIA novum

Genotype, *Barydexia bivittata* sp. nov., Luzon.

Differs from *Calotheresia* as follows: Head width scarcely equal to head height; length of clypeus twice width of clypeus;

facial carina high, wide; length of epistoma equal to width of epistoma; vibrissæ far above oral margin level; vibrissal axis equal to antennal axis, latter three-fifths head height; palpi subcylindric, bristled, little thickened at tip; 3 sternopleurals, 2 postacrostichals; 2 heavy wide black thoracic vittæ; no median marginals on first apparent or second actual abdominal segment, no median discals on intermediate segments of abdomen.

BARYDEXIA BIVITTATA sp. nov.

Length of body, 12 to 15 millimeters; length of wing, 11.5 to 14.5. Two males, Mount Banahao, Laguna Province, and Baguio, Benguet Subprovince, Luzon.

Head and thorax very pale brassy, including scutellum; frontalia black; antennæ and facial carina pale brownish fulvous, second antennal joint at times brown; palpi brown, paler on tip; thoracic vittæ equilateral, very wide, coalesced behind in black horseshoe following edge of postscutum from wing base to wing base and including base of scutellum; abdomen fulvous yellow, median vitta and hind border of last 3 abdominal segments dark brown; clypeus and fourth apparent or fifth actual abdominal segment silvery pollinose; legs black; wings smoky yellow on base and costal half, thinly infuscate on rest; squamæ smoky yellowish.

CALOTHERESIA BIVITTATA sp. nov.

Length of body, 15 millimeters; length of wing, 12. One male, Surigao, Mindanao.

Differs from both *C. sumatrensis* and *C. formosensis* by the four thoracic vittæ of male being coalesced into two broad and even thoracic vittæ, except only that a split shows on forward half of prescutum; no preacrostichals; only 1 small median discal on intermediate segment of abdomen; pollen of upper parts pale brassy tinged, sides of body gray.

TRICHOSTYLUM FASCIATUM sp. nov.

Length of body, 9 to 10 millimeters; length of wing, 8 to 8.5. Four males, Butuan and Iligan, Mindanao (*Baker 12453*).

Dark brown, densely silvery pollinose; head silvery, frontalia dark brown; antennæ and palpi pale fulvous brown; cheek grooves fulvous brown in oblique view, wholly pollinose in direct view; whole mesoscutum, scutellum, and abdomen thickly deep soft silvery with faint suggestion of brassy, the dark parts being a lateral spot and three narrow thoracic vittæ on prescutum, over front half of postscutum with irregular hind border, rather narrow base of scutellum, all of first apparent or second actual abdominal segment, second apparent or third actual abdominal segment except narrow front edge, less than hind half of third apparent or fourth actual abdominal segment and about hind third of fourth apparent or fifth actual abdominal segment; legs brown; wings whitish on base, smoky brown on middle and costa and following wing veins, irregular inner half nearly clear; squamæ whitish, concolorous with wing base.

DOLESCHALLA MAKILINGENSIS sp. nov.

Length of body, 11 to 13.5 millimeters; length of wing, 8 to 10. Four males, Mount Maquiling, Luzon (*Baker 1824* and *2020*).

Head dull silvery, dark brown stripe from lower border of eye to below oral margin of epistoma, parafrontalia appearing dull fulvous in oblique view; frontalia bright brown; antennæ brown, second antennal joint subfulvous to pale brownish; palpi brownish fulvous; humeri, pleura, and sides of mesoscutum silvery with slight brassy tinge, leaving two heavy irregular dark thoracic vittæ with a linelike one confluent with each on its inner side; scutellum bright brown, tip and postscutellum dull silvery pollinose; brown blotch under wing base; abdomen brown to dark brown, sides of first three abdominal segments yellow to rufofulvous on outer half or more, bases of last three abdominal segments narrowly and evenly silvery pollinose; legs brown, coxæ pollinose; wings narrowly deeply smoky blackish on costa, very dilute on rest; squamæ glassy, with faint sordid tinge.

Genus LOPHOSIOPSIS novum

Genotype, *Lophosiopsis costalis* sp. nov., Luzon.

Differs from *Euphania* as follows: Proboscis very short, haustellum hardly longer than thick and scarcely the length of the rather large labella; palpi slender cylindric, as long as lower border of head, projecting beyond oral margin of epistoma, faintly thickened tip in male; third antennal joint three times second antennal joint in male; eyes bare, oblique, reaching far short of vibrissal level; 1 strong proclinate frontoörbital in male; frontalia well narrowed posteriorly in male, short, distance of lunula to ocellar triangle on median line twice their anterior width, width of frontalia not twice width of parafrontal in middle; parafacialia narrowed below, equal to facialia reversed; cheeks rather over one-fourth eye length; 2 or 3 postacrostichals; 1 small separated discal scutellar; apical cell narrowly open not far before wing tip, narrow and long-pointed, spearhead-shaped; cubitulus a very wide obtuse angle, subangular, well over one-third wing width from hind margin of wing; male claws not over last tarsal joint; 1 millimeter on second apparent or third actual abdominal segment, marginal row of 6 or more on fourth apparent or fifth actual abdominal segment; actual fifth abdominal segment functioning as anal segment in male.

LOPHOSIOPSIS COSTALIS sp. nov.

Length of body, 8 millimeters; length of wing, 7. One male, Baguio, Benguet, Luzon.

Head silvery, parafrontalia more blackish through pollen; frontalia soft blackish brown, pruinose in oblique view; antennæ blackish; third antennal joint except extreme tip dusky fulvous inside, outer side and arista brown; palpi dark brown; occipital beard whitish; pleura silvery shading to dark with light incidence; mesoscutum, scutellum, and abdomen dark metallic greenish; mesoscutum and scutellum thinly silvery, leaving four dark thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—narrow; intermediate segments of abdomen very narrowly silvery on bases but widening out on venter, extending along median line of second apparent or third actual abdominal segment and same on venter of first apparent or second actual abdominal segment; legs black, femora and coxæ silvery; wings narrowly blackish on costa from stigma to tip of third radial or second vein, rest of costa and basal cells yellowish, otherwise nearly clear; squamæ glassy.

Genus MAKILINGIMYIA novum

Genotype, *Makilingimyia melanoptera* sp. nov., Luzon.

Differs from *Zambesa* (*Z. makilingensis* Tyler-Townsend) as follows: Frontal profile not so long as facial profile; oral profile very short, beveled anteriorly; clypeus slightly depressed, equilateral, narrow, fully 3 times width of clypeus; epistoma cut off slightly above vibrissal level; facialia narrow, parallel, flattened but raised some above clypeal plane, with short microsetæ halfway or less; vibrissæ very short, barely decussate, but well differentiated; vibrissal axis scarcely two-thirds antennal axis, latter hardly three-fifths head height; proboscis short, haustellum not over one-fourth head height, labella rather large; third antennal joint narrow, four times second antennal joint or more, upper edge concave in profile, widened slightly before the truncate tip; arista length of third antennal joint, slightly thickened halfway, short pubescent; width of vertex in male one-fourth head width, in female little more, front widening to two-fifths head width at base of antennæ; face of male in middle half head width, of female two-fifths head width and same as anterior front; frontals stopping at base of antennæ, about 6, weak, front pair or two stronger; no outer verticals, male and female, inner verticals not decussate; frontalia very wide, equilateral, over four times width of parafrontal in middle; parafrontalia with sparse setæ which descend below base of antennæ; parafacialia long, equilateral, over half in male and under half in female width of clypeus; cheeks one-fourth eye length; cheek grooves pollinose; thorax wider than abdomen; 3 sternopleurals, 2 lateral scutellars, apical scutellars strong and decussate; small cross vein normal, first long vein terminating considerably beyond it; third long vein bristled only at base or exceptionally one-third way to small cross vein; apical cell very narrowly open, practically closed, a little before wing tip; cubitulus a rounded obtuse angle; apical cross vein slightly bent in; hind cross vein over half its length from cubitulus; last section of fifth long vein half hind cross vein; squamæ rounded-subovate and widened behind; hind tarsi rather short, especially in male; abdomen narrow, equilateral, of 5 abdominal segments, little over one and a half times thorax in length, truncate behind in male; no median marginals on first apparent or second actual abdominal segment, 1 median marginal on third apparent or fourth actual abdominal segment; hypopygium in female small, anal retracted, terminating in two setose papillæ with polished knob between them, as seen in profile.

MAKILINGIMYIA MELANOPTERA sp. nov.

Length of body, 8 to 9 millimeters; length of wing, 7 to 8. Two males and one female, Mount Maquiling, Luzon (*Baker 2023*).

Head silvery, posterior narrowed part of parafrontalia blackish, face and anterior part of parafrontalia in male golden; frontalia, antennæ, and palpi brown to blackish; occipital beard grayish; pleura silvery, mesoscutum and scutellum thinly silvery leaving two heavy wide equilateral black thoracic vittæ; abdomen dark brown or blackish, basal half of intermediate segments of abdomen and whole fourth apparent or fifth actual abdominal segment thinly silvery above, sides and venter silvery except hind half of third apparent or fourth actual abdominal segment; legs black, femora and coxæ silvery; wings black, more dilute in female; squamæ white, with narrow blackish edge in male.

Genus PHILIPPOLOPHOSIA novum

Genotype, *Philippolophosia ornata* sp. nov., Panay.

Differs from *Lophosiodes* as follows: Frontal profile nearly flat, considerably sloped, three-fourths facial profile; occipital profile a little bulged on middle; vibrissal axis fully equal to antennal axis, latter three-fifths head height; female, width of vertex one-fourth head width, front widening gently and evenly to one-third head width at base of antennæ; face in middle scarcely half head width; 1 proclinate frontoörbital in female, strong, with 1 setalike just behind it; 1 weaker divaricate reclinate frontoörbital; 3 sternopleurals, 2 postintraalars, 2 weak preacrostichal bristles, 3 postacrostichals, 1 discal scutellar weaker than apical scutellars; hind cross vein hardly its length from cubitulus; metatarsi not equal to following joints; female front tarsi not widened; 1 median marginal on first apparent or second actual abdominal segment; first hypopygial segment in female subcylindric and about twice as long as wide, second hypopygial segment bifurcate with arms toothed on inside and each with a stout, blunt, convergent terminal hook.

PHILIPPOLOPHOSIA ORNATA sp. nov.

Length of body, 12 millimeters; length of wing, 9.75. One female, northwestern Panay.

Head tawny silvery, parafrontalia light golden, occiput golden above; frontalia fulvous brown; antennæ and palpi fulvous, third antennal joint edged with brownish; occipital beard brassy; humeri, pleura, and edges of mesoscutum light golden; disk of mesoscutum dark, thinly tawny silvery pollinose; 4 dark thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—a little narrower; scutellum fulvous, thinly light golden pollinose; abdomen subshining brown, shading to brownish fulvous or fulvous on venter; first apparent or second actual abdominal segment to third apparent or fourth actual abdominal segment thickly golden pollinose, leaving a bare wide hind border on first apparent or second actual abdominal segment, a wide triangle on posterior part of second apparent or third actual abdominal segment, narrow triangle on hind border of third apparent or fourth actual abdominal segment, while first apparent or second actual abdominal segment and second apparent or third actual abdominal segment are largely bare on sides of venter; hypopygium rufofulvous, terminal hooks shining black; legs pale fulvous, tibiæ testaceous, tarsi black; wings light yellowish, fading on irregular inner half, wing tip touched with smoky; squamæ tawny glassy.

Genus PSEUDORECTOCERA novum

Genotype, *Pseudorectocera albifacies* sp. nov., Mindanao.

Differs from *Orectocera* as follows: Epistoma cut out extremely short, wide, rim flared; facialia finely short-ciliate in an irregular double row nearly to base of antennæ; vibrissæ well differentiated, below oral margin level, long enough for tips to meet; palpi long, somewhat bowed, inflated and somewhat flattened apically, bare on the flattened and widened tips in female; arista length of third antennal joint, considerably thickened two-thirds way and tapered, short-pubescent on upper side nearly to tip, second aristal joint twice as long as wide; cheeks one-fourth eye length; third long vein bristled one-third way or more to small cross vein; apical cell well open considerably before wing tip; tarsi scarcely elongate; abdomen subcylindric, somewhat widened on middle and well deepened posteriorly; 1 median marginal on first apparent or second actual abdominal segment.

PSEUDORECTOCERA ALBIFACIES sp. nov.

Length of body, 13 millimeters; length of wing, 10.5. One female, Dapitan, Mindanao.

Shining black; head burnished silvery, parafrontalia shading to blackish posteriorly; frontalia soft deep black, antennæ and palpi brownish black; upper central part of occiput blackish; humeri and pleura silvery; cut by brown subvertical bands between leg bases; mesoscutum thinly silvery, leaving two very heavy, regular, and approximated black thoracic vittæ; scutellum very thinly silvery; abdomen black, bases of intermediate segments of abdomen silvery, widening on sides and venter, first apparent or second actual abdominal segment showing some rust brown pollen on venter; legs black, femora and coxæ silvery on outside; wings deeply black infuscate, with lighter areas in apical cell, discal cell, and on inner margin; squamæ white, subtranslucent.

Genus ZAMBESA Walker

The new species described below appears to agree well with the characters of the genotype of *Zambesa;* but, since no positive assurance can yet be given on this point, its generic characters are here described.

Body elongate and narrow; head not much wider than high; frontal profile nearly straight, sloped but very prominent, hardly longer than facial profile; latter extremely receding, straight, at right angle to frontal profile or slightly greater; oral profile half length of frontal profile, slightly arcuate; occipital profile a little inflated below; clypeus moderately sunken, length of clypeus over twice width of clypeus; facial carina showing only as a faint sharp ridge on median line; epistoma full width, very short, edge scarcely warped; facialia bare, narrow, rather on edge, a few bristles next vibrissæ; vibrissæ strong, decussate, on oral margin of epistoma and on lower border of head; vibrissal axis hardly over half antennal axis, latter three-fourths head height; proboscis half head height, stout, labella very large, haustellum shorter than labella; palpi long, clavate and swollen, but not very stout, bowed, rather longer than labella; base of antennæ well above eye middle; antennæ long, reaching oral margin level, second antennal joint short, third antennal joint about six times second antennal joint and equilateral; arista long, bare, thickened not one-fourth way, basal joints short; eyes bare, somewhat oblique, cut out a little on lower hind border, not reaching vibrissal level; female width of vertex one-fourth head width, front widening faintly to one-third head width at base of antennæ, a little depressed between eyes in front view; face only slightly widened from front in female, not two-fifths head width in middle, appearing little wider than front but wider than width of eye; frontals 5, hugging edge of frontalia and stopping before base of antennæ; 2 verticals, male and female, inner verticals decussate; 2 proclinate frontoörbitals and 1 reclinate frontoörbital, male and female; frontalia in female equilateral, rather over width of parafrontal in middle; ocellars proclinate; parafrontalia widened anteriorly and produced, sloped 45°, practically bare; parafacialia bare, narrowed some below, no wider than facialia in middle, at 40° to clypeal plane; no facioörbitals nor genoörbitals; cheeks one-sixth eye length; cheek grooves small; thorax same width as abdomen, little narrower than head; 2 strong sternopleurals and postintraalars, 3 postsutural dorsocentrals, 2 or 3 short but rather strong preacrostichals, 2 fairly long postacrostichals; prescutum and postscutum about equal in length; 2 long strong lateral scutellars, no apical scutellars, usually 1 discal scutellar; wings rather long and narrow, costal spine absent; first long vein bare, terminating little beyond wing middle; small cross vein distinctly to far basad of second subcostal or auxiliary vein termination, scarcely over 3 times its short length from costal side of third long vein origin; third long vein bristled only at base, yet the 3 or 4 bristles placed at usual distance apart reach halfway to small cross vein; apical cell short-petiolate fairly well before exact wing tip, stalk in line with third long vein and not so long as small cross vein; cubitulus an obtuse angle, one-fourth wing width from hind margin of wing; apical cross vein crooked, not parallel to hind margin of wing, bent in before tip; no stump of vein at cubitulus; hind cross vein strongly sinuate, much nearer cubitulus, yet over its length from same; fifth long vein bare, last section not one-third preceding; squamæ small, rounded, level part subcircular; tarsi rather long; hind tibiæ with short hairs and few bristles; middle metatarsi and hind metatarsi equal to following joints; front tarsi in female normal; male and female claws equal to last tarsal joint; abdomen nearly equilateral, thickening posteriorly in profile but appearing cylindric from above, twice length of thorax; basal of first actual abdominal segment showing distinctly from above and fully half length of first apparent or second actual abdominal segment, noticeably narrower than latter, so that abdomen is somewhat constricted at base; 1 strong median marginal on first 2 abdominal segments, 1 median discal on last 3 abdominal segments, marginal row on last 2 abdominal segments; hypopygium in female large, caudoventral aspect.

ZAMBESA MAKILINGENSIS sp. nov.

Length of body, 11 millimeters; length of wing, 9.5. Two females, Mount Maquiling (*Baker 2019*) and Los Baños, Luzon. One male, Surigao, Mindanao (*Baker 23237*), is evidently the same genus and probably the same species.

Head, pleura, and coxæ deeply silvery pollinose; frontalia dark brown, antennæ lighter brown, arista pale yellowish on thickened part; palpi fulvous to dark brown, in latter case (Los Baños) pale yellowish below and on tips; mesoscutum and scutellum thinly silvery, lateral and hind edges of both prescutum and postscutum deeply silvery, two narrow brown thoracic vittæ on prescutum with a brownish spot each side, disk of postscutum brown; abdomen brown to dark brown or blackish, venter of first apparent or second actual abdominal segment to third apparent or fourth actual abdominal segment pale yellow except hind border; dorsum of basal or first actual abdominal segment and first apparent or second actual abdominal segment blackish or brown, with more or less yellowish showing on each side of first apparent or second actual abdominal segment; dorsum of second apparent or third actual abdominal segment yellow except hind border and wide median vitta; front half of third apparent or fourth actual abdominal segment yellow, except a broad median triangle; abdomen silvery pollinose on bases of all abdominal segments and whole fourth apparent or fifth actual abdominal segment; legs dark brown to blackish, femora except tips yellow, tibiæ with more or less yellowish on middle; wings lightly smoky yellow, with clearer central area; squamæ watery to pearly whitish.

RHODOGYNE PHILIPPENSIS sp. nov.

Length of body, 7 millimeters; length of wing, 5.5. One male, Mount Maquiling, Luzon (*Baker 7154*).

Head pale golden yellow pollinose, parafrontalia and posterior half of frontalia deeper golden, viewed from before, rest of frontalia brownish fulvous; antennæ and occipital area of cheeks brown, palpi very pale fulvous; occipital beard brassy; mesoscutum, tip of scutellum, and postscutellum dull golden, rest of scutellum and over hind half of postscutum shining blackish except median spot on hind margin of latter; abdomen orange-yellow, extreme base and median spot on hind margin of first 3 abdominal segments brownish black; legs blackish brown; wings broadly fulvous yellow costobasally, blackish infuscate across middle and nearly clear on tip and hind border; squamæ pale golden.

Genus CRYPTOSPYLOSIA novum

Genotype, *Cryptospylosia angustifrons* sp. nov., Luzon.

Differs from *Spylosia* as follows: Frontal profile equal to facial profile; clypeus moderately sunken, nearly equilateral, length of clypeus two and a half times width of clypeus; facialia ciliate with 9 to 11 strong bristles nearly to lowest frontals; vibrissal axis two-thirds antennal axis, latter three-fourths head height; palpi rather longer than haustellum, bowed; base of antennæ well above eye middle; third antennal joint in male five times second antennal joint, narrow, equilateral; eyes thickly long-hairy, oblique, reaching well short of vibrissal level; male width of vertex one-tenth head width, front narrowed somewhat before ocellar triangle and then, widening to one-fifth head width at base of antennæ; face in middle two-fifths head width; 1 or 2 reclinate frontoörbitals in male, weak; male frontalia not equal to width of parafrontal in middle; parafacialia a little narrowed below, no wider at narrowest than widest part of facialia; cheeks two-sevenths eye length; 3 sternopleurals, 2 preacrostichals, 2 postacrostichals, 3 long slim lateral scutellars, no apical scutellars; costal spine very short; no wrinkle at cubitulus; 2 median discals in file on intermediate segments of abdomen in male.

CRYPTOSPYLOSIA ANGUSTIFRONS sp. nov.

Length of body, 10.5 millimeters; length of wing, 9. One male, Baguio, Benguet, Luzon (*Baker 23246*).

Head gray cinereous, with faint brassy sheen on occiput, parafrontalia, and parafacialia; frontalia and antennæ brown, third antennal joint slightly ferruginous on extreme base; palpi fulvous yellow; pleura brassy ashy; mesoscutum and scutellum silvery whitish, base of scutellum and rectangle in middle of postscutum next transverse suture of mesoscutum brown; 4 black thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—somewhat narrower before transverse suture of mesoscutum and merged in a brown rectangle behind same; abdomen rufofulvous, depression of first apparent or second actual abdominal segment, median vitta, and hind borders of other abdominal segments dark brown to blackish, last two abdominal segments and base of second apparent or third actual abdominal segment thinly silvery; legs blackish, femora brownish; wings faintly yellowish on base and costa; squamæ yellowish, whitish on inner disk.

Genus BOTRIOPSIS novum

Genotype, *Botriopsis bakeri* sp. nov., Luzon.

Differs from *Botria* as follows: Frontal profile four-fifths facial profile; epistoma long, full width, not twice as long as wide; facialia heavy, wide, faintly bowed, oblique inside and outside crests, ciliate with strong bristles to lowest frontals; vibrissæ well above oral margin level; haustellum one-third head height, labella very large; palpi length of haustellum; width of vertex in female two-fifths head width, front widening rapidly to five-ninths head width at base of antennæ; face in middle nearly two-thirds head width; female with 1 vertical, 2 proclinate frontoörbitals and 3 reclinate frontoörbitals; frontalia hardly half width of parafrontal in middle; no ocellars; parafacialia above equal to width of clypeus, narrowed below, setose on upper two-thirds; prescutum far shorter than postscutum; apical scutellars half length of lateral scutellars, strongly decussate; cubitulus rounded nearly right angled or faintly obtuse angled, apical cross vein well bent in at base; hind tibiæ ciliate with long and short bristles.

BOTRIOPSIS BAKERI sp. nov.

Length of body, 11 millimeters; length of wing, 10. One female, Baguio, Benguet, Luzon.

Head dull golden; frontalia and antennæ blackish, second antennal joint and base of third antennal joint rufous; palpi fulvorufous; pleura and mesoscutum dull golden; 5 blackish thoracic vittæ, median vitta narrower and reaching as far back as outer pair of thoracic vittæ, inner pair of thoracic vittæ—when 4 or more present—stopping in middle of postscutum; scutellum rufotestaceous, thinly dull golden pollinose; abdomen dull golden pollinose, first apparent or second actual abdominal segment and broad hind borders of intermediate segments of abdomen blackish, latter color giving out on venter; femora dull golden pollinose, tibiæ dull rufous, tarsi blackish; wings pale yellowish smoky on base and narrow costal margin; squamæ glassy whitish, with yellow edges.

Genus PROPHORICHAETA novum

Genotype, *Prophorichaeta philippina* sp. nov., Luzon.

Differs from *Phorichaeta* as follows: Vibrissal axis scarcely less than antennal axis, latter little over half head height; proboscis two-thirds head height; second antennal joint short, third antennal joint 3 times second antennal joint; 1 vertical in female, not descussate; 2 proclinate frontoörbitals in female, strong; cheeks two-fifths eye length; 3 sternopleurals, 2 preacrostichals; third long vein bristled two-thirds to three-fourths way to small cross vein; stalk of apical cell little over small cross vein; hind cross vein somewhat nearer cubitulus; last section of fifth long vein equal to hind cross vein.

PROPHORICHAETA PHILIPPINA sp. nov.

Length of body, 6.5 millimeters; length of wing, 5. One female, Baguio, Benguet, Luzon.

Head and body metallic dark greenish; head silvery; frontalia brown, with bloom in oblique view; antennæ blackish, extreme base of third antennal joint faintly reddish; palpi obscure brownish; thorax very thinly silvery, mesoscutum and scutellum with scarcely traces of pollen on disk; abdomen with last three abdominal segments thinly bluish silvery on base; legs black; wings tinged with brownish on costa and wing veins; squamæ tawny.

Genus PHILIPPODORIA novum

Genotype, *Philippodoria fasciata* sp. nov., Mindanao.

Differs from *Zizyphomyia* as follows: Epistoma one-fourth as long as wide; vibrissæ a little above oral margin level; palpi well thickened at tip in male; second antennal joint short; third antennal joint in male five times second antennal joint, moderately wide, equilateral, subtruncate at tip; eyes large, slightly oblique, reaching oral margin level; male, width of vertex two-sevenths head width, front equilateral on hind half and then widening very gradually to hardly one-third head width at base of antennæ; face only widening slightly from front, little over one-third head width in middle; frontals 8 in all, 3 below base of antennæ; only 1 frontal row in male; parafacialia narrowed below, half width of clypeus above and one-third width of clypeus below, microsetose above, not transversely corrugated; cheeks one-eighth eye length in male; 4 lateral scutellars; costal spine short but distinct; cubitulus right angled, angular, hardly one-fifth wing width from hind margin of wing; apical cross vein deeply arcuate inward; metatarsi equal to following joints.

PHILIPPODORIA FASCIATA sp. nov.

Length of body, 7 millimeters; length of wing, 6. One male, Kolambugan, Mindanao.

Head silvery; parafrontalia, ocellar triangle, and upper occipital orbits light golden; frontalia and antennæ blackish; palpi fulvous; sternopleura silvery, mesopleura with more golden tinge; mesoscutum, apical half of scutellum, and less than basal half of last three abdominal segments golden pollinose including postscutellum, rest of scutellum and abdomen black; 4 black thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—shorter; legs brownish black; wings nearly clear, very faintly yellowish on costa and wing veins; squamæ whitish, faintly tinged with yellowish.

Genus STURMIODORIA novum

Genotype, *Sturmiodoria facialis* sp. nov., Basilan.

Differs from *Philippodoria* as follows: Clypeus scarcely depressed or but faintly so, length of clypeus twice width of clypeus; epistoma cut short; facialia bare, flattened and ironed practically into clypeal plane; vibrissæ on oral margin level; haustellum short and bulbous, scarcely longer than the large labella; base of antennæ little above eye middle; female, third antennal joint hardly three and a half times second antennal joint, equilateral, rather wide, subtruncate; eyes not oblique, reaching vibrissal level; female, width of vertex two-sevenths head width, front widening to two-fifths head width at base of antennæ; face nearly equilateral, four-ninths head width in middle and below; frontals 1, below base of antennæ; 2 proclinate frontoörbitals and 3 reclinate frontoörbitals in female; frontalia faintly widened posteriorly in female, little over half width of parafrontal in middle, with long fine hairs on edges; no ocellars; cubitulus rounded right angled; apical cross vein gently bent in before halfway point; hind cross vein not its length from cubitulus.

STURMIODORIA FACIALIS sp. nov.

Length of body, 9 millimeters; length of wing, 7. One female, Basilan (*Baker 11780*).

Head silvery; frontalia and antennæ brown, base of third antennal joint slightly tinged with ferruginous; palpi fulvous; pleura and mesoscutum silvery gray; 4 blackish thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—narrower; scutellum blackish on base, narrowly testaceous on tip, silvery gray pollinose; abdomen blackish, last three abdominal segments except hind borders silvery gray pollinose; legs blackish; wings nearly clear; squamæ whitish, faintly tawny, with yellow edges.

Genus EOCARCELIOPSIS novum

Genotype, *Eocarceliopsis bakeri* sp. nov., Mindanao.

Differs from *Hemisturmia* as follows: Clypeus narrowed upward, length of clypeus rather over twice width of clypeus; epistoma gently warped; facialia bare; vibrissal axis hardly two-thirds antennal axis; latter little over half head height; haustellum hardly one-third head height, labella nearly as long; eyes reaching far below oral margin level; male, width of vertex one-fifth head width, front equilateral on hind half and then widening to less than one-third head width at base of antennæ; face in middle two-fifths head width; 2 reclinate frontoörbitals in male; frontalia well narrowed posteriorly, equal to width of parafrontal in middle; ocellars strong; cheeks scarcely one-tenth eye length; cubitulus angular; no wrinkle at cubitulus; metatarsi equal to following joints, middle metatarsi exceed same; abdomen short-ovate; 1 weaker median marginal on first apparent or second actual abdominal segment, 1 strong median marginal on second apparent or third actual abdominal segment.

EOCARCELIOPSIS BAKERI sp. nov.

Length of body, 9 millimeters; length of wing, 7.5 Two males, Dapitan, Mindanao (*Baker 12459*).

Head dull silvery gray, parafrontalia with a very faint brassy tinge; frontalia and antennæ brown; palpi fulvous; pleura dull silvery, mesoscutum same with scarcely perceptible tinge of brassy; 4 blackish thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—very narrow before transverse suture of mesoscutum; scutellum blackish on basal half, fulvous on crescentic marginal area, thinly silvery and tawny pollinose; abdomen blackish, basal half or more of last three abdominal segments brassy silvery; legs dark brownish, tibiæ blackish; wings nearly clear, scarcely yellowish on costa; squamæ slightly yellowish tinged.

A female from the same locality is closely similar in appearance and color, but may not belong here. The eyes scarcely reach oral margin level and the cheeks are one-fifth eye length, while the front and face are much wider, front being nearly half head width at base of antennæ and face fully half head width in middle.

Genus PSEUDOKEA novum

Genotype, *Pseudokea neowinthemioides* sp. nov., Mindanao.

Differs from *Okeopsis* as follows: Epistoma warped; facialia flattened and ironed almost into clypeal plane, only slightly oblique, width of facialia quite twice width of parafacial; vibrissal axis a little less than antennal axis, latter two-thirds head height; arista longer than whole antennæ, slender throughout; frontals 2 below base of antennæ; verticals 1 in male, not decussate; frontalia haired, a little narrowed posteriorly, twice width of parafrontal in middle; cheeks one-seventh eye length and nearly completely inferior aspect; apical scutellars decussate, as long as middle lateral scutellars; hind tibiæ thickly ciliate with flattened bristles, without longer bristle; no median marginals on first two abdominal segments.

PSEUDOKEA NEOWINTHEMIOIDES sp. nov.

Length of body, 10 millimeters; length of wing, 7. One male, Cagayan, Mindanao.

Head silver gray; frontalia and antennæ brown, third antennal joint mostly paler; palpi fulvous; facialia brown; pleura and humeri silvery gray; mesoscutum thinly silvery, 4 blackish thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—narrow; scutellum fulvous, narrowly brown on base, silvery pollinose; abdomen subfulvous, dorsal depression of first apparent or second actual abdominal segment, middle of second apparent or third actual abdominal segment, middle and hind border of third apparent or fourth actual abdominal segment, and whole fourth apparent or fifth actual abdominal segment brown or blackish; over front half of intermediate segments of abdomen and narrow base of fourth apparent or fifth actual abdominal segment silvery pollinose; hypopygium fulvous, legs dark brown, tarsi more blackish; wings yellowish on base and costa; squamæ whitish, edges faintly yellow.

Genus EUHYPOCHAETOPSIS novum

Genotype, *Euhypochaetopsis orientalis* sp. nov., Luzon.

Differs from *Hypochaetopsis* as follows: Frontal profile only faintly curved, nearly equal to facial profile; clypeus dished, epistoma well warped; male, third antennal joint four and a half times second antennal joint, not thickened; arista strongly thickened little over one-fourth way; eyes rather thickly pilose, pushed forward below but occipital area of cheeks following close to their hind borders; male, width of vertex little over one-fifth head width, front at base of antennæ three-elevenths head width; frontals, 2 closely set below base of antennæ, and 3 or 4 above; costal spine very short and practically absent; apical cell moderately widely open; cubitulus nearly one-third wing width from hind margin of wing.

EUHYPOCHAETOPSIS ORIENTALIS sp. nov.

Length of body, 7 millimeters; length of wing, 7. One male, Baguio, Benguet, Luzon.

Head, pleura, and venter silvery whitish; front including frontalia, mesoscutum, scutellum, and dorsum of abdomen pale brassy pollinose; antennæ black; palpi fulvous; 4 equal, narrow, olive brown thoracic vittæ; first apparent or second actual abdominal segment and hind half or so of last three abdominal segments obscure blackish; legs blackish, tibiæ subfulvous; wings smoky yellowish except inner border; squamæ glassy yellowish.

Genus HYSTRICOVORIA novum

Genotype, *Hystricovoria bakeri* sp. nov., Luzon.

Differs from *Catalinovoria* as follows: Head width one and a half times head height; frontal profile strongly arcuate, little over facial profile; occipital profile not bulged; head profile semicircular; clypeus well sunken, narrow, over twice width of clypeus; epistoma cut short; facialia flattened-oblique; vibrissæ on oral margin level; vibrissal axis hardly two-thirds antennal axis, latter three-fifths head height; proboscis very short; haustellum small, bulblike, equal to labella; palpi short, clavate, with few bristles; male, third antennal joint two and a half times second antennal joint; eyes reaching slightly below vibrissal level; male, width of vertex one-third head width, front faintly widening to middle; face and anterior front equilateral, little over one-third head width; 4 frontals in all, 2 widely separated below base of antennæ and reaching to aristal level; 3 reclinate frontoörbitals in male, hind divaricate and short, the other 2 strong; frontalia two-thirds width of parafrontal in middle; ocellar triangle very large, triangular, splitting frontalia one-third way; parafacialia bare, strongly narrowed below, peglike, almost pointed below; cheeks one-eighth eye length, occipital area of cheeks scarcely entering; 2 sternopleurals, no pteropleurals, 2 postintraalars; cubitulus two-fifths wing width from hind margin of wing; hind cross vein much nearer to small cross vein, nearly straight, nearly parallel to hind margin of wing and apical cross vein; last section of fifth long vein four-fifths preceding; metatarsi not equal to following joints; 1 erect median marginal on second apparent or third actual abdominal segment.

HYSTRICOVORIA BAKERI sp. nov.

Length of body, 5.5 millimeters; length of wing, 4. One male, Mount Maquiling, Luzon.

Head bluish silvery, frontalia brown; antennæ black, basal joints reddish yellow; palpi pale fulvous, thorax bluish silvery, 4 indistinct black thoracic vittæ, inner pair of thoracic vittæ—when 4 or more are present—narrow; abdomen shining black, bases of intermediate segments of abdomen bluish silvery; legs black; wings clear; squamæ nearly white.

Genus ORILLIOPSIS novum

Genotype, *Orilliopsis orientalis* sp. nov., Luzon.

Differs from *Brachymeropsis* as follows: Oral profile not long, well beveled anteriorly; clypeus narrow, length of clypeus two and a half times width of clypeus; epistoma gently curve-warped from clypeus; haustellum setose and two-thirds head height; palpi slender, subfiliform, half length of haustellum, bristled, not thickened at tip; second antennal joint short, third antennal joint three and a half times second antennal joint in female; arista thickened halfway and tapered; female, width of vertex fully one-third head width, front nearly equilateral but over one-third head width at base of antennæ; face and anterior front equilateral; frontals 3 in all; inner verticals not decussate; prescutum a little shorter than postscutum; 2 sternopleurals and 1 very weak one below; no costal spine; squamæ small, little widened, rather rounded behind; abdomen cylindric, nearly twice length of thorax, of 4 abdominal segments, intermediate segments of abdomen longer than the others.

ORILLIOPSIS ORIENTALIS sp. nov.

Length of body, 6.5 millimeters; length of wing, 5. One female, Mount Maquiling, Luzon.

Head silvery white, parafrontalia blackish posteriorly; frontalia dark brown; antennæ and palpi blackish; pleura silvery; mesoscutum and scutellum very thinly pollinose from side view, appearing bare shining blackish when viewed from above; 4 black thoracic vittæ faintly outlined before transverse suture of mesoscutum in oblique view; abdomen black, bases of last three abdominal segments thinly silvery; legs black; wings clear; squamæ glassy.

BRACHYMEROPSIS LUZONENSIS sp. nov.

Length of body, 6.5 millimeters; length of wing, 5.5. One male, Baguio, Benguet, Luzon.

Differs from *B. sumatrensis* Tyler-Townsend by the palpi being much shorter than third antennal joint, apical cell practically closed, costal spine very short, prescutum more shining, and thoracic vittæ much less distinct.

APHRIMYOBIA JAPONICA sp. nov.

Length of body, 7.75 millimeters; length of wing, 6.5. One female, Kobe, Japan.

Differs from *A. simillima* Tyler-Townsend by the third antennal joint being three times second antennal joint, arista short-pubescent, width of vertex two-sevenths head width, front at base of antennæ one-third head width, ocellars differentiated but very fine and short, 1 postacrostichal, 2 preacrostichals, no discal scutellars, apical cell very narrowly open a little before wing tip, apical cross vein slightly arcuate inward, pollen of mesoscutum and scutellum silvery but very thin, second apparent or third actual abdominal segment black above except narrow front border on each side of median vitta, wings yellowish costally, squamæ nearly white. The prescutum is much shorter than the postscutum.

DIE STAPHYLINIDEN DER PHILIPPINEN

24. BEITRAG ZUR INDO-MALAYISCHEN STAPHYLINIDENFAUNA

Von Max Bernhauer

Öff. Notar in Horn, Nied. Oesterreich

Genus PAEDERUS Fabricius

1. Geflügelte Arten, Flügeldecken länger als der Halsschild........................ 2.
Ungeflügelte Arten, Flügeldecken viel kürzer als der Halsschild........ 4.
2. Hinterleib einfarbig bläulich schwarz, Halsschild rotgelb, der übrige Körper blau, Beine schwarz. Luzon, Provinz Mountain, Trinidad (*Banks*); Baguio (*Baker*): Provinz Rizal, Montalban Gorge (*Banks*).. **P. philippinus** Bernhauer.
Hinterleib rötlichgelb mit schwarzer Spitze... 3.
3. Kopf so lang als breit, weitläufig punktiert, Flügeldecken sehr fein und spärlich punktiert. Luzon, Manila (*Banks*): Provinz Laguna, Los Baños, Mount Maquiling (*Baker*); ausserdem von den Sunda-Inseln bekannt.. **P. intermedius** Boheman.
Kopf viel länger als breit, dicht runzelig punktiert, Flügeldecken ziemlich kräftig und sehr dicht runzelig punktiert. Ziemlich glänzend, dünn gelblich behaart, Kopf und Hinterleibsspitze schwarz, die Brust pechfarben, der Halsschild, das Schildchen, die vier ersten freiliegenden Hinterleibsringe, die Wurzel der schwärzlichen Fühler, die Taster und Beine rötlichgelb, die Knie nicht gebräunt. Kopf fast von der Form eines regelmässigen Sechseckes, kräftig und ziemlich gleichmässig dicht runzelig punktiert, ziemlich matt. Fühler mässig lang, die vorletzten Glieder doppelt so lang als breit. Halsschild oblong, ziemlich schmal, glänzend, im ersten Drittel am breitesten, nach vorn gerundet, nach rückwarts geradlinig verengt, ausser der breiten, unpunktierten Mittelzone mässig fein und ziemlich weitläufig punktiert. Flügeldecken viel länger als der Halsschild, viel länger als zusammen breit, mässig glänzend. Hinterleib fein und wenig dicht, am siebenten Tergit dichter und feiner punktiert. Länge, 7 Millimeter. Samar, Catbalogan (*Böttcher*)...... **P. samarensis** sp. nov.
4. Kopf und Halsschild stark metallisch glänzend blaugrün bis messingfarben, der übrige Körper schwarz, die Wurzel des achten Tergites gelb, die Fühler schwarz, die zwei ersten Glieder, die Wurzel des dritten und das Endglied rötlichgelb, die Taster rötlichgelb mit geschwärzter Spitze des vorletzten Kiefertastergliedes, die Beine schwarz, die äusserste Wurzel der Schenkel, bei var. *lividipes* die Basalhälfte der Schenkel rötlichgelb. Kopf kurz elliptisch innerhalb der Fühlerhöcker mit je einem starken Eindruck, glänzend glatt, neben den Augen mit einigen ungleich grossen Punkten, auf der hinteren Hälfte mit wenigen weiteren sehr feinen Punkten. Fühler dünn und lang, die vorletzten Glieder dreimal so lang als breit.

Halsschild hoch gewölbt, kurz eiförmig mit zwei etwas unregelmässigen Rückenreihen, sonst nur gegen die Vorderecken mit wenigen sehr feinen Pünktchen. Flügeldecken nur ein Drittel so lang als der Halsschild, an der Naht, kürzer als am Hinterrande breit, matt chagriniert, mit einigen seichten Punkten, vor der Basis mit einem mehr oder minder tiefen und grossen Eindruck. Hinterleib chagriniert, jedoch ziemlich glänzend, fein und spärlich punktiert. Die Seiten des Körpers mit mässig langen, schwarzen Borsten besetzt. Länge, 12 bis 13 Millimeter. Beim Mann ist das sechste Sternit der ganzen Länge nach schmal ausgeschnitten, die Seiten des Ausschnittes parallelseitig, dessen Spitze verrundet. LUZON, Provinz Mountain, Mount Polis und Pauai (Haight's place) (*Böttcher*). , **P. semiviridis** sp. nov.

Kopf und Halsschild nicht metallisch glänzend.................. 5.

5. Kopf schwarz .... 6.

Kopf rötlichgelb .... 9.

6. Flügeldecken glänzend, nicht chagriniert, fein aber scharf punktiert, pechschwarz, glänzend, spärlich graugelb behaart, die Flügeldecken schwarzblau, die Taster und die ganzen Beine sowie die Wurzel und Spitze der gebräunten Fühler rötlichgelb. Kopf rundlich, fast so breit als der Halsschild, spärlich und unregelmässig punktiert. Fühler mässig lang, die vorletzten Glieder kaum doppelt so breit als lang. Halsschild eiförmig, gewölbt, etwas breiter als die Flügeldecken, mit zwei mässig feinen Rückenreihen, seitlich spärlich und unregelmässig punktiert. Flügeldecken nach rückwärts erweitert, schmal, an der Naht fast um die Hälfte länger als breit, vor der Basis eingedrückt, deutlich und ziemlich dicht punktiert. Hinterleib fein und sehr spärlich punktiert. Länge, 6.5 Millimeter. LUZON, Provinz Mountain, Trinidad (*Böttcher*). Ein einziges Stück. **P. bang-haasi** sp. nov.

Flügeldecken matt chagriniert, nicht oder nur undeutlich punktiert.... 7.

7. Halsschild oblong, an den Seiten nur mässig erweitert, wenig breiter als die Flügeldecken, Mittel- und Hinterschenkel an der Spitze breit geschwärzt. PALAWAN, Binaluan. LUZON, Provinz Mountain, Mount Polis (*Böttcher*).................. **P. lativentris** Wendeler.

Halsschild viel kürzer, an den Seiten stark erweitert, mindestens um die Hälfte breiter als die Flügeldecken, die Schenkel nicht oder nur wenig angedunkelt.................. 8.

8. Flügeldecken und Hinterleib dunkel schwarzblau, erstere ganz matt, Halsschild doppelt so breit als die Flügeldecken. Der Körper ist schwarz, die Taster, Beine, und Fühler rötlichgelb, letztere mit geschwärzten mittleren Gliedern, die Knie der Mittel- und Hinterbeine schwach gebräunt. Kopf viel schmäler als der Halsschild, sechseckig, etwas länger als breit, nach rückwärts geradlinig verengt, die Augen vor der Mitte gelegen, die Oberfläche mit wenigen feinen Punkten. Fühler gestreckt, die vorletzten Glieder doppelt so lang als breit. Halsschild mächtig entwickelt, kugelig gewölbt, um ein Viertel breiter als lang, vor der Mitte am breitesten, nach vorn und rückwärts gleichmässig gerundet verengt, auf der Oberfläche unpunktiert, spiegelblank. Flügeldecken halb so breit und ein Drittel so lang als der Halsschild, nach rückwärts erweitert, an der Naht so lang als am Hinterrande breit, matt chagriniert und mit wenigen seichten Punkten besetzt, vor der Mitte stark quer eingedrückt. Hinterleib quer gestrichelt chagriniert, aber doch ziemlich glänzend, nach rückwärts stark erweitert, einzeln punktiert. Länge, 7 Millimeter. LUZON, Provinz Nueva Vizcaya, Imugan (*Böttcher*). Ein einzelnes Stück.. **P. grandicollis** sp. nov.

Flügeldecken und Hinterleib schwarz, erstere weniger dicht chagriniert, deutlich etwas glänzend. Kopf etwas kürzer und breiter, nach rückwärts sanft gerundet verengt. Fühler fehlend. Halsschild etwas länger, weniger breit und weniger gewölbt, nur um die Hälfte breiter als die Flügeldecken, diese etwas breiter. Länge, etwas über 7 Millimeter. MINDANAO, Provinz Zamboanga, Dapitan (*Baker*). Ich besitze von dieser Art nur ein einziges Exemplar.
P. bakerianus sp. nov.

9. Halsschild dunkel, kugelig. Pechbraun, der Halsschild dunkler, der Kopf rötlichgelb, bisweilen seitlich mit einem dunklen Längswisch, die drei ersten freiliegenden Hinterleibsringe heller braun, das vierte freiliegende (sechste Tergit) und die schmale Wurzel der folgenden Tergite und die korrespondierenden Teile der Sternite rötlichgelb, die Taster und Beine, sowie die Wurzel und die Spitze der sonst geschwärzten Fühler blass rötlichgelb, die Knie ziemlich breit gebräunt. Kopf kurz elliptisch, schmäler als der Halsschild, nur ganz vereinzelt punktiert. Fühler sehr gestreckt, dünn, die vorletzten Glieder dreimal so lang als breit. Halsschild beim Mann fast kugelig, nur wenig länger als breit, beim Weib viel schmäler und länger, nur um die Hälfte breiter als die Flügeldecken, vor der Mitte am breitesten, mit wenigen Punkten besetzt. Flügeldecken schmal, beim Mann nur halb so breit als der Halsschild, bei beiden Geschlechtern halb so lang als dieser, ziemlich matt chagriniert, einzeln und undeutlich körnig punktiert, vor der Mitte quer eingedrückt, im übrigen sehr uneben. Hinterleib nach rückwärts etwas erweitert, ziemlich kräftig und spärlich punktiert, ziemlich glänzend. Der Körper ist mit zahlreichen langen, schwarzen Borsten besetzt. Länge, 7 bis 9 Millimeter. Beim Mann ist das sechste Sternit schmal und gleichbreit, der ganzen Länge nach ausgeschnitten. LUZON, Provinz Nueva Vizcaya, Imugan (*Böttcher*).. **P. flaviceps** sp. nov.

Halsschild rötlichgelb, eiförmig. Von dem vorigen durch Färbung, längeren Halsschild, kürzere viel dichter skulptierte Flügeldecken verschieden. Der Körper ist blassgelb, die Hinterleibsspitze und die Knie breit schwärzlich. Der Halsschild ist um die Hälfte länger als breit, die Flügeldecken matt chagriniert, noch unebener als beim vorigen, mit zahlreichen, Borsten tragenden Körnchen besetzt. Ich war fast versucht, diese Art nur für ein unreifes Stück des *flaviceps* zu halten. Da jedoch die dunkle Färbung der Schenkel sich viel weiter, bis über die Mitte erstreckt, was bei einem unausgefärbten Exemplar gewiss nicht der Fall wäre, bin ich der Meinung, dass wir es hier mit einer von *flaviceps* verschiedenen Art zu tun haben. Länge, 6.2 Millimeter (bei eingezogenem Hinterleib). LUZON, Provinz Mountain, Balbalan (*Böttcher*)........................... **P. lividus** sp. nov.

PHILIPPINE SURGEON FISHES AND MOORISH IDOLS

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SIXTEEN PLATES AND TWO TEXT FIGURES

ACANTHURIDÆ

SURGEON FISHES

Body more or less oblong or ovoid, usually elevated, and much compressed laterally, the skin more or less leathery and covered with small to minute, more or less shagreenlike scales; the tail is armed on each side with one to several acute movable spines, or fixed knives or sharp-keeled bony plates, or these may be reduced to mere tubercles; in most the spines or knifelike plates form very efficient cutting weapons. Mouth small to very small, often placed very low, terminal or inferior, each jaw with a single row of fixed or movable incisors; vomer and palatines toothless; premaxillaries slightly movable but not protractile, the short maxillary closely united to premaxillary; gill rakers obsolete; pseudobranchiæ large; gills 4, a slit behind the fourth; gill membranes attached to isthmus, the openings restricted to the sides; dorsal fin single, usually with strong spines, the rayed portion longer than the spinous part; anal fin like the soft dorsal; ventrals thoracic, I–5 or I–3; the intestinal canal long, often much convoluted, pyloric cæca present; air bladder large, forked posteriorly; vertebræ $9 + 13 = 22$. The pelvic bones long, narrow, curved, closely connected, evident through the skin.

Herbivorous shore fishes, some representatives occurring in all tropical seas, mostly small to medium in size, a few kinds reaching a length of about two-thirds of a meter. All of them are edible and some are excellent eating when properly prepared. Mostly they are dull-colored, brown or blackish fishes, but a few are gaudily striped or marked or brilliantly decorated; some kinds are notable for their singular or fantastic appearance.

The young of these fishes present an entirely different appearance in their earlier stages, and a number of kinds were described under the name *Acronurus*, a genus created for these larval forms. In the very young the body is proportionately shorter and more or less orbiculate or disklike; there are no scales, but the skin is corrugated with numerous transverse vertical striæ or folds, the opercles and breast silvery. As yet no one has made sufficiently extensive studies of the larval development and *Acronurus* stages of these fishes to be able to say positively to what species they belong, except in a very few cases.

Japanese fishermen catch them by the *muro ami* net method, sometimes a single haul netting as much as 2,000 kilograms. The surgeon fishes occur in schools about submerged reefs, at moderate depths, coming into shoal water to feed. Comparatively few are caught by the fishing methods of the Christian Filipinos. I am greatly indebted to Mr. T. Tamaki and his associates, Japanese fishermen operating from Manila southward in the Visayas, for many fine specimens otherwise unobtainable.

Surgeon fishes are excellent food fishes. The flesh is firm without being hard, is flaky, and of very good flavor. Few Americans or Europeans appreciate these fine fishes, and the well-to-do Tagalogs are ignorant of their good qualities. They therefore bring a very low price and are bought by the poorest people. Many much poorer fish sell for much more. They can be cooked with or without the skin, but it should always be removed before the fish is served.

A good-sized surgeon or nose fish cooked as follows is a dish worthy of any occasion:

1 onion, 1 green pepper, 1 ripe tomato. Chop fine, add 1 teaspoonful salt and ½ teaspoonful white pepper. Add 1 cup water, 2 tablespoonfuls butter, Crisco, or other fat, 1 tablespoonful of flour.

Clean and skin the fish, remove head and gills. Lay in pan and place dressing on top. Bake twenty-five minutes in a hot oven, or thirty minutes if the fish is a very large one. Slip from baking pan upon a hot platter without disturbing the dressing, pour any gravy over it, and serve.

Key to the Philippine genera of Acanthuridæ.

a^1. A single movable spine on each side of tail.
  b^1. Dorsal spines 9, rarely 8.
    c^1. Teeth truncate or pointed, mostly fixed, never all movable.
      d^1. Ventrals I–5 .... **Acanthurus.**
      d^2. Ventrals I–3 .... **Paracanthurus.**
    c^2. Teeth elongate, setiform, freely movable, the tips dilated on one side .... **Ctenochaetus.**
  b^2. Dorsal spines 4 or 5; soft dorsal and anal high to very high. **Zebrasoma.**
a^2. Each side of caudal peduncle with one or more bony plates, usually bearing a sharp knifelike keel .... **Naso.**

Genus ACANTHURUS Forskål

Acanthurus FORSKÅL, Descrip. Anim. (1775) 59.

Vernacular names.—English, lancet fish, surgeon fish, tang; Tagalog, *indangan, labahita, samaral;* Samal and Tao Sug, *indangan, kumay, salias, dorong;* Visayan, *indangan, mungit.*

Dorsal IX– (rarely VIII–) 20 to 32; anal III– (in one species II–) 20 to 29; ventral I–5.

This genus includes those Acanthuridæ in which each side of tail is armed with a sharp movable needlelike or lancetlike spine, directed forward and fitted into a groove in the caudal peduncle; the mouth is very small, each jaw with a single row of lobate or denticulate, truncate or pointed incisors which are sometimes movable, and are usually set diagonally and are more or less imbricate; the spinous part of the dorsal is less developed than the rayed portion.

Body laterally compressed, often much flattened, elongate or deep, and covered with small to minute ctenoid or spinescent scales; pseudobranchiæ well developed; branchiostegals 5; air bladder large, forked posteriorly; the intestine has several large folds; pyloric appendages; vertebræ 9 (rarely 8) + 13.

This genus, found in all tropical seas, shares with its closest relatives the possession of the characteristic sharp caudal spine, which is indeed a frightful weapon. In using it the fish strikes sideways, its lancet held erect at right angles to the body. The lancet fishes abound around coral reefs, moving about in schools and grazing upon marine algæ. Most of the species are dull-colored, uniformly brown, or marked by fine blue dots and lines, or with more or less yellow. Some however are very gaudily marked.

Key to the Philippine species of Acanthurus.

a^1. Body and head pale, with black crossbars........................ **A. triostegus.**
a^2. No black crossbars.
  b^1. A yellow, scarlet, or black stripe or mark on shoulder or above upper angle of gill opening.
    c^1. A circular bluish black spot or ring behind eye above gill opening; sides with many fine blue longitudinal lines................ **A. bariene.**
    c^2. A longitudinal bar on shoulder.
      d^1. Shoulder bar black; a narrow black pointed bar from caudal spine to middle of body.. **A. gahm.**
      d^2. Shoulder bar orange or yellow, broadly margined with black. **A. olivaceus.**
  b^2. No spot or longitudinal stripe or bar on shoulder.
    e^1. A whitish or bluish ring around the mouth or lower jaw.

f^1. A large naked red, yellow, or white rhombic or ovate spot on posterior part of trunk, including caudal spine...... **A. achilles.**

f^2. No large colored spot posteriorly on side of trunk.

g^1. A large crescentic pearly spot beneath eye; a white line at base of dorsal and anal, orange posteriorly and widening almost to top of last rays.......... **A. aliala.**

g^2. No crescentic white, pearly, or blue spot under eye.

h^1. Caudal with a wide yellow or orange crossband on posterior margin; opercle margined by a broad black band; nostrils blue or white, conspicuous; a white spot near angle of preopercle; caudal spine black.......... **A. celebicus.**

h^2. A broad bluish white band across base of caudal; caudal spine white; a wide bluish band across breast and joined by a band on each side to ring about the mouth. **A. leucocheilus.**

e^2. No whitish or bluish ring around mouth or lower jaw.

i^1. Sides of body with longitudinal lines or stripes.

j^1. Back and sides yellow, the belly pale; 8 to 10 horizontal or slightly oblique blue lines from head to back and caudal fin; each blue line with a broad brown band on each side; 2 or 3 curved blue lines from eye; ground color appears as broad yellow bands.......... **A. lineatus.**

j^2. Body not banded and striped as above.

k^1. Body with bluish or pale longitudinal lines or with dots or spots arranged in lengthwise series.

l^1. A black spot in axil of dorsal and anal.

m^1. Uniform brown, the sides with paler or bluish dots, forming irregular longitudinal lines, occurring also on scaled part of vertical fins; no blue stripes on cheeks .... **A. atramentatus.**

m^2. Reddish brown or dusky brown with blue longitudinal lines on sides; 7 longitudinal blue lines on sides of head, the 3 upper ones crossing snout and uniting with those on other side; a blue band across interorbital .... **A. bleekeri.**

l^2. No black axillary spot on dorsal and anal. Uniform brown with a broad bright yellow or pale interocular band; many wavy blue or brown longitudinal lines on head, breast, nape, and sides; vertical fins banded with blue and yellow, or uniform brown.......... **A. dussumieri.**

k^2. Body uniformly brown or blackish brown, without bluish or pale longitudinal lines or rows of dots.

n^1. A black or chocolate brown spot in axil of dorsal and anal.

o^1. Sides of head and body above pectoral base with small circular whitish or blue spots, axillary spots deep chocolate brown; 11 or 12 teeth on each side of upper jaw .... **A. marginatus.**

o^2. No spots on sides of head and above pectoral; axillary spots black; 6 teeth on each side of upper jaw. **A. nigroris.**

- n^2. No black axillary spot on dorsal and anal.
  - p^1. A more or less distinct wide pale or whitish band on base of caudal; dorsal and anal with 4 or 5 orange bands alternating with lavender or blue bands, these usually disappearing in alcohol; teeth 9 on each side; depth 1.7 to 1.9 times in length................ **A. matoides.**
  - p^2. No wide pale or whitish band on caudal base.
    - q^1. Color black; sides of head and breast blackish brown; a deep brown ring around caudal base; fins black; 8 broad rounded teeth on each side above, 8 or 9 below.. **A. mindorensis.**
    - q^2. Color dark purplish brown, caudal pale brownish yellow; other fins black or deep chocolate brown; teeth narrow, pointed, 10 on each side above, 12 to 14 below .... **A. philippinus.**

ACANTHURUS TRIOSTEGUS (Linnæus). Plate 1, fig. 1.

Chaetodon triostegus LINNÆUS, Syst. Nat. ed. 10 1 (1758) 463.

Acanthurus triostegus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 215; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 144; GÜNTHER, Cat. Fishes 3 (1861) 327; Fische der Sudsee 1 (1875) 108; DAY, Fishes of India (1878) 204, pl. 48, fig. 2.

Hepatus triostegus JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 270.

Harpurus fasciatus FORSTER, Descrip. Anim. ed. Lichtenstein (1844) 216.

Chaetodon zebra LACÉPÈDE, Hist. Nat. Poiss. 3 (1798) pl. 25, fig. 3.

Acanthurus zebra LACÉPÈDE, Hist. Nat. Poiss. 4 (1798) 546, pl. 6, fig. 3.

Teuthis australis GRAY, in King's Survey Coasts Australia 2 (1827) 435.

Acanthurus hirudo J. W. BENNETT, Fishes Ceylon (1834) 11, pl. 11.

Acanthurus subarmatus F. D. BENNETT, Whaling Voyage 2 (1840) 278.

Vernacular names.—Ilocano, *cabcabalan;* Tagalog, *ray tapis.*

Dorsal IX–21 to 24; anal III–19 to 21.

The oblong ovoid body laterally compressed but plump, depth 1.95 to 2 times, head 3 to 3.3 times in length; anterior dorsal profile convex from origin of dorsal to the bulging interorbital, then concave to lips, or upper part of profile may be straight or nearly so, snout concave; ventral profile a uniform arch from chin to caudal peduncle; eye rather small, high up, near profile, 4 to 4.6 times in head, but larger proportionally in young specimens; snout thin, broad tipped, about 1.5 times in head; interorbital broad, rounded, bulging laterally at upper anterior margin of eye, 3 to 3.3 times in head; posterior margin of preopercle very steeply inclined, angle broadly rounded, depth twice in head; the small terminal mouth very low down, with 7 broad, rounded or blunt, lobate teeth on each side of upper jaw, the denticulations extending laterally nearly to their base; dorsal and anal of moderate height, rounded posteriorly; dorsal spines stout, first very short but not concealed, last twice to 2.3 times in head; dorsal and anal rays equal to or slightly greater than last dorsal spine, decreasing in length at posterior angle; anal spine equals or slightly exceeds last dorsal spine; the thick caudal peduncle somewhat flattened dorsoventrally, its depth 2.87 to 3 times in head; caudal short, with slightly concave posterior margin, 3 to 3.66 times in length; caudal spine very small, half or less than half diameter of eye in length; pectoral 1.1 to 1.2 times in head; ventral broad, 1.35 to 1.55 times in head.

The color in life of specimens from Puerto Galera, Mindoro, was pale greenish above, white below, with six black transverse bands on sides, each about as wide as pupil of eye; a black longitudinal line along middle of snout; the dorsal may be uniform green, or golden may be intermingled with the green; anterior part of dorsal with a narrow black margin.

The color in alcohol varies from cream to gray brown or dark brown, snout and nape darkest; breast, belly, and underside of caudal peduncle cream color; 5 narrow vertical or curved black or blackish brown crossbands, first passing through eye and curving forward below it, second stopping behind pectoral base; a blackish brown spot or bar on base of pectoral; a median band of the same color along snout from interorbital to its tip; a brown bar or saddle, or a spot of the same color on top and side of caudal peduncle and another spot on side near lower margin, the latter spot sometimes disappearing; a dark brown line, disappearing posteriorly, separates the cream-colored undersurface from the brown of the sides; dorsal dark brown to pale brown, darkest anteriorly, or posterior marginal region may be pale or colorless; anal pale cream with a broad brown longitudinal band covering most of it; both dorsal and anal may fade to pale cream; anal dark to pale brown or whitish, with a cream colored or white margin; caudal brown to whitish; pectoral pale yellowish to colorless; ventrals white, suffused with brown, or all gray or white.

Here described from the following specimens, ranging in length from 24 to 150 millimeters.

Paraoir, La Union Province, 1.
Tailon Island, 1.
Iba, Zambales Province, 2.
Nasugbu, Cavite Province, 2.
Puerto Galera, Mindoro, 2.
Calapan, Mindoro, 20.
Balabac, 3.
Tubigan, Sulu Province, 1.
Pearl Bank, Sulu Province, 1.
Guam, 5.

I have also examined specimens from Paoay, Ilocos Norte, and Nasugbu, Batangas, in the collection of the College of Agriculture.

This handsome species was recorded by Jordan and Richardson from Calayan and Fuga Islands of the Babuyanes, and from Cagayancillo in the Sulu Sea. Elsewhere this fish occurs from Ceylon to Guam, and southeast in the tropical Pacific to the Marquesas. The very closely related *A. sandvicensis* (Streets) is found from the Hawaiian Islands to the offshore islands of Mexico.

ACANTHURUS BARIENE Lesson. Plate 1, fig. 2.

Acanthurus bariene LESSON, Voy. Coquille, Zool. 2 (1830) 150.
Acanthurus nummifer CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 172; GÜNTHER, Cat. Fishes 3 (1861) 338.

Dorsal IX–26; anal III–24.

The depth of the broadly ovoid compressed body 1.94 to 2 times in its length, deepest between ventrals and anal, the depth diminishing rapidly toward caudal peduncle; nape compressed, elevated, anterior dorsal profile very strongly convex; with age the snout may become protuberant and overhang the mouth; ventral profile deeply and evenly arched from isthmus below chin to caudal peduncle; head set diagonally, 3.5 to 3.88 times in length; the eye varies much with age, 3.85 to 4.5 times in head and 2.86 to 3.93 times in the large deep snout which has its greatest bulge below level of eye and is 1.16 to 1.38 times in head; the broad and more or less elevated interorbital space 3 to 3.85 times in head; the inferior mouth projects diagonally downward, with large tumid lips; 10 teeth on each side of upper jaw, 11 in lower jaw; upper teeth broadly pointed, and denticulate back upon sides some distance; the very short first dorsal spine entirely concealed in thick skin, and all the spines slender and comparatively weak, with only their tips exposed, the last one 1.38 to 1.7 times in head; dorsal rays equal to or a fifth higher than the spines, posterior angle of fin pointed; anal resembles dorsal, third spine 2 to 2.2 times in head, anal rays as high as last dorsal spine, posterior angle with an elongate sharp tip; pectoral and ventrals a little more or less than head; depth of caudal peduncle 2.3 to 2.6 times in head; caudal deeply lunate with very long attenuate pointed tips of about equal length, 1.9 to 1.95 times in head; caudal spine large, thick, sharp-pointed both anteriorly and behind, pale or colorless, 2.5 to 3 times in head.

Fresh specimens were brown, with many fine wavy longitudinal blue striæ on sides, golden spots and short vermiculated lines on cheeks, and a more or less circular blue-black spot behind eye above gill opening; the dorsal was golden, except the last 5 rays which were dark violet, with 4 or 5 diagonally longitudinal violet-blue lines near margin; the anal was brown like the body, violet-blue posteriorly, with 3 longitudinal blue lines on outer portion and a marginal sky blue band; both dorsal and anal with a sky blue band along base; the caudal was bluish dusky posteriorly, with golden brown spots on lobes; the pectoral was brown basally, the rest blue-black, fading into brown marginally, with a yellow transverse bar near extremity; the ventrals were brown basally, the outer two-thirds blue-black; the caudal spine was in a blue-black spot.

Color in alcohol uniformly dark brown to blackish brown, posterior half darkest, with very many fine blue longitudinal lines, or the region above pectoral may be more or less suffused with yellowish; above upper end of gill opening and directly behind eye is a circular violet-black spot, smaller than eye, and fading in the smaller specimens; vertical fins darker than body, or dorsal may be more or less yellow; below base of dorsal is a violet-black band, broadest anteriorly and tapering back to a line which disappears about halfway to caudal; above it is a light blue line running the whole length of base; there are three longitudinal blackish violet lines along margin of dorsal, the outer one broadest; the anal has a basal and a marginal violet or blue longitudinal line; caudal shows traces of a pale basal ring; upper and lower margins of caudal brown to light brown, the lobes more or less barred or spotted, the central portion darker, becoming violet-brown to violet-black posteriorly; pectoral blackish, with a lemon yellow transverse bar near outer extremity, the bar prone to disappear in alcohol; ventrals blackish violet. In life there was evidently a broad blue band on chin. The caudal spine has a blackish brown sheath in larger specimens, a white sheath in the smaller specimens.

Here described from four specimens, 218 to 280 millimeters in length; three from Ibajay, Capiz Province, Panay, and one from Tablas. I have also studied three very fine specimens from Ambil Island, 280 to 345 millimeters in length, and one, 310 millimeters long, from Maricaban Island. I place here a specimen, 240 millimeters long, from Bantayan Island. Instead of a black shoulder spot it has a violet-black line encircling an area on the shoulder more than twice the size of eye; the caudal has a wide bluish white ring on its base, the whole central part of fin black; the caudal spine is in a deep black spot. The shoulder mark on this specimen is much like that described for *Acanthurus tennenti* Günther.

This fish is abundant on rocky reefs in the central Visayas. The species is unique and has hitherto been known only from the type specimen, collected by Garnot at Waigiou, about 1824, and described first by Lesson, later by Valenciennes. The discovery of this fish in abundance in the Philippines constitutes one more link in the chain which binds so firmly together the Moluccas, northwestern New Guinea, and the Philippines, at least so far as their reef-dwelling fishes are concerned.

ACANTHURUS GAHM (Forskål). Plate 12, fig. 2.

Chaetodon gahm FORSKÅL, Descrip. Anim. (1775) 64.

Acanthurus gahm CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 160; RÜPPELL, Atlas Fische (1828) 58; GÜNTHER, Cat. Fishes 3 (1861) 338; Fische der Südsee 1 (1873) 113, pl. 74; WEBER, Fische, Siboga Exp. (1913) 318.

Dorsal IX–25; anal III–23 to 24.

The oblong body is deepest before anal fin, much compressed laterally, anterior profile convex to very boldly convex, snout becoming vertical or even protuberant and overhanging mouth, depth twice, head 3.5 to 3.7 times in length; the long snout varies much in contour, becoming more and more curved in age, 1.25 to 1.4 times in head; the eye varies much in size, 3.7 to 4.6 times in head, 2.9 to 3.4 times in snout; interorbital may be broad and relatively low, or elevated and more appressed, 2.8 to 2.2 times in head; posterior margin of preopercle steeply inclined, the broadly rounded angle beneath anterior margin of eye or posterior or anterior nostril, its depth 1.6 to 1.7 times in head; mouth small, low, distinctly inferior, opening obliquely downward, with 9 teeth on each side in upper jaw, the denticulations on their tips extending up the sides for half their length; 10 teeth on each side in lower jaw; first dorsal spine very short, entirely concealed, second spine almost entirely concealed by thick skin; none of the spines strong, the last one 1.77 times in head; dorsal not high, angulate posteriorly, the rays a trifle higher than the spines; third anal spine 2.2 to 2.3 times in head; the anal is like the dorsal in shape but the rays are a little lower, and the posterior angle is more acute and longer; pectoral equal to or a little more or less than head; ventrals pointed, the first ray in old specimens elongate and with a somewhat filiform tip, equal to or a trifle shorter than head; depth of caudal peduncle 2.4 to 2.5 times in head; caudal deeply lunate, with elongate, sharp-pointed tips, the upper a little the longer, 1.95 to 2.1 times in length; the broad acutely pointed caudal spine has a short projection backward, 4.36 to 4 times in head.

A living specimen in the Bureau of Science aquarium is grayish blue, brownish gray, or dusky brownish, according to light conditions and the state of its excitement, with a broad white band at caudal base and on caudal peduncle, and a dull blue spot on nape before origin of first dorsal; a broad black bar extends back from eye above anterior half of pectoral and a very narrow, elongate, triangulate, pointed black stripe extends forward from the black caudal spine, halfway to tip of pectoral; lips bluish white, posterior margin of opercle black; dorsal yellowish orange, anal brownish orange, each with a dark blue band along base, margin of anal vivid blue; caudal pale gray in strong light, dusky slate blue in dim light, with a broad bluish white band along its posterior margin, its upper and lower margins deep blue; pectoral blackish, with a broad lemon yellow crossbar posteriorly, its posterior margin clear.

Color in alcohol deep brown to blackish brown, the vertical fins concolorous or darker, with a black longitudinal bar on shoulder, beginning a little behind eye and running back as far as above middle or posterior third of pectoral, broadest posteriorly; from the black caudal spine an elongate, narrow, black, triangulate, pointed bar extends forward halfway to pectoral; this is absent in specimens 100 millimeters or less in length; in some specimens the dorsal is more or less yellow on the basal anterior half; the dorsal has a black marginal line, the anal a narrow blue or black margin; the caudal has a posterior white margin, within which is a black crescentic bar; some large specimens show a broad white ring or crossbar on caudal base; the pectoral has a broad posterior yellow margin, fading to pale or colorless; some specimens have a white or pale spot on anterior margin of eye, and some have the body more or less yellowish above pectoral.

Here described from 10 specimens, varying in length from 92 to 210 millimeters, from the following localities:

Tablas, 1.	Basbas Island, Sulu Province, 1.
Bantayan, 2.	Bungau, Sulu Province, 1.
Samal Island, Davao Gulf, 1.	Clarendon Bay, Balabac, 4.

This species is common in the central and southern Philippines; it occurs elsewhere from the Red Sea to the Gilbert Islands and southward to Samoa, the Society, and the Paumotu Islands.

ACANTHURUS OLIVACEUS Bloch and Schneider. Plate 12, fig. 1.

Acanthurus olivaceus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 213; GÜNTHER, Cat. Fishes 3 (1861) 336; Fische der Südsee 1 (1875) 113.

Teuthis olivaceus JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1903) 358, fig. 23; Bull. U. S. Fish Comm. 23^1 (1903) (1905) 385, fig. 166.

Hepatus olivaceus JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 270.

Acanthurus eparai LESSON, Voy. Coquille, Zool. 2 (1830) 147; Atlas (1826) Poissons, pl. 27, fig. 1.

Acanthurus humeralis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 170; EYDOUX and SOULEYET, Voy. Bonite 1 (1849) 169, pl. 2.

Harpurus paroticus FORSTER, Descrip. Anim. ed. Lichtenstein (1844) 183.

Dorsal IX–22 to 23; anal III–21 to 23.

Body oblong ellipsoid, compressed laterally but rather thick, depth 2 to 2.3 times, head 3.5 to 3.7 times in length; the anterior dorsal profile varies from a boldly convex arc to an irregular sinuous curve which is almost vertical on front of snout; the nape and especially the snout are laterally compressed, the snout sometimes so strongly projecting as to be almost protuberant and the profile concave above eyes; snout 1.33 to 1.44 times in head; eye rather small, about 4.75 times in head and 3.3 to 3.5 times in snout; interorbital about 3.25 times in head; posterior margin of preopercle inclined at about 45°, the angle obtusely rounded, the depth 1.7 to 1.8 times in head; mouth very low, with protuberant lips, and 8 or 9 teeth on each side of upper jaw, their broad tips lobulate-denticulate and the sides denticulate for half their length; the anterior nostril has a thin low membranous tubule becoming a high flap at rear; posterior nostril much smaller, with a thin low membranous margin except at rear; first dorsal spine low, its tip not embedded in skin, last spine twice in head; dorsal rays a little higher than the longest spine, those at posterior angle about a fifth longer and forming a long-tipped pointed angle; third anal spine 2.66 to 2.7 times in head; anal like dorsal but lower, but sometimes the long-pointed rays of posterior angle are equal to dorsal; the broad pectoral a little shorter than head; the pointed ventral three-fourths to five-sixths the length of head; depth of the stout caudal peduncle 2.6 to 2.7 in head; caudal lunate with very long, narrow, almost filiform tips, 1.7 to 2 times in length; the stout knifelike caudal spine has a long sharp posterior point, 2.6 to 2.7 times in head.

Color in life dark olive brown, with a broad, bright, deep yellow or orange bar, broadly margined with black or dark brown, beginning as a circular spot on opercle at angle and running back horizontally along side to middle of body; the dark margin of shoulder bar is broadest posteriorly and does not merge into the body color; posterior part of pectoral whitish or with a broad yellow margin, the rest of fin very dark brown; a broad milk white crescent on posterior margin of caudal, very narrowly edged with black, the elongate caudal lobes pale brown spotted with dark brown; caudal spine covered with a very dark brown sheath, its groove edged with blackish.

Color in alcohol similar, the shoulder bar often fading to pale buff or whitish and the yellow on pectoral largely disappearing; dorsal and anal much darker brown than body, or blackish.

In some fresh specimens the shoulder bar is scarlet or some shade of red.

Here described from six specimens, 165 to 230 millimeters in length, from the following localities:

Subic Bay, Olongapo, Zambales Province, 1.
Ambil Island, 2.
Agutaya Island, Cuyo Islands, 2.
Jolo, Sulu Province, 1.

This very distinct species does not seem to be abundant with us, but the Japanese fishermen have recently begun to catch a good many among the Cuyo Islands. Jordan and Richardson had a specimen from Cagayancillo, in the Sulu Sea.

It is widely distributed in the Pacific Ocean, from Formosa to Tahiti. It is common in the Caroline and Hawaiian Islands. In the East Indies it is known from Celebes and the Moluccas.

ACANTHURUS ACHILLES Shaw. Plate 2, fig. 1.

Acanthurus achilles SHAW, Gen. Zool. 4 (1803) 383; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 160; GÜNTHER, Cat. Fishes 3 (1861) 340; Fische der Südsee 1 (1873) 115, pl. 71, fig. B; STEINDACHNER, Denkschr. Akad. Wiss. Wien. 70 (1900) 493.

Teuthis achilles FOWLER, Proc. Acad. Nat. Sci. Phila. (1900) 513.
Hepatus achilles JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 384, pl. 58; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 350; STEINDACHNER, Sitzungsb. Kais. Akad. Wiss. 115[1] (1906) 1393.

Dorsal IX–31; anal II–27.

Body very broadly ovoid, very much laterally compressed, greatest depth 1.5 times in length; head placed obliquely, twice in depth, three times in length, its upper profile strongly convex to below eyes; snout moderately concave, a little more than 1.4 times in head; eye high up, circular, 2⅓ times in snout, 3⅓ times in head, and 1.1 times in the slightly ridged interorbital; posterior margin of preopercle begins beneath posterior margin of eye and descends very steeply; angle of preopercle 1.76 times in head; the small mouth low, terminal, with equal jaws, and but 4 broad, blunt, irregularly lobate teeth on each side of upper jaw; dorsal and anal alike in shape, of moderate height, the dorsal spines graduated in length to the last, which is highest; first dorsal spine not concealed, 7.5 times in head, the last one 1.57 times in head; anterior dorsal rays a trifle higher than last spine, 1.5 times in head, the posterior rays rapidly shortened; second anal spine 3.75 times in head; first anal ray stout, coarse, spinelike in appearance; the middle anal rays equal the longest dorsal rays in height; caudal peduncle much compressed laterally, its depth 2.72 times in head; caudal lunate, with elongate tips, the upper the longer, its length 1.2 times head; pectoral a tenth longer than head; the pointed ventral 1.2 times in length of head; caudal spine needle-pointed, a little shorter than eye.

Color in alcohol uniform chocolate brown, with a large ovate or rhombic naked white spot on posterior part of trunk, including caudal spine; a blue line at base of dorsal rays; above it is a wider tan or pale brown stripe, widest posteriorly, and a similar one at base of anal rays; a blue line from one angle of mouth to the other, encircling chin; the membranous posterior flap of opercle creamy white; basal portion of caudal blackish brown, then pale brown, then a blackish brown crescent followed by a broad marginal whitish crescent; outer margin of ventral blue, rest of fin blackish brown.

Here described from a specimen, 92 millimeters long, from Guam. In life this is a brilliantly colored fish. The patch on the side is bright scarlet or orange. The submarginal crescent on caudal is of the same color, and the anal stripe and upper stripe on dorsal base are likewise scarlet or orange.

This beautiful fish ranges from the China Sea to Hawaii and Samoa. It reaches a length of 230 millimeters.

I have seen no specimen from the Philippines, but there is no question of its occurrence here.

ACANTHURUS ALIALA Lesson. Plate 2, fig. 2.

Acanthurus aliala LESSON, Voy. Coquille, Zool. 2 (1830) 150.

Teuthis aliala JORDAN and EVERMANN, Fishes North America 2 (1898) 1693; SEALE, Occ. Papers Bishop Mus. 1 (1901) 109.

Hepatus aliala JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 350.

Acanthurus glaucopareius CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 139; KITTLITZ, Mus. Senckenb. 1 (1834) 192, pl. 13, fig. 3; BLEEKER, Acta Soc. Sci. Indo-Neerl. 1 (1856) Beschriv. Vischsoorten Amboina, 47; GÜNTHER, Cat. Fishes 3 (1861) 339; Fische der Südsee 1 (1873) 114, pl. 71, fig. A.

Dorsal IX–28 or 29; anal III–25 or 26.

Depth of the short, strongly compressed, ovate body 1.7 to 1.76 times, head 3.4 to 3.6 times in length; anterior dorsal profile strongly convex from origin of dorsal to below eye, then concave to tip of snout; head small, very oblique, its length twice in depth; the large circular eye 2.75 to 2.9 times in head, 2 to 2.16 times in snout, which is much compressed laterally and 1.25 to 1.35 times in head; the broad, rounded, projecting interorbital equals eye; posterior margin of preopercle very steeply inclined, the angle broadly rounded with no perceptible lower limb, its depth 1.7 to 1.8 times in head; mouth very small, downward projecting, with 5 short broad teeth on each side of upper jaw, their truncate margin lobate denticulate; dorsal and anal rather low, rounded posteriorly, the very short first dorsal spine not concealed; dorsal spines moderately strong, the last one about two-thirds as long as head, anterior and middle dorsal rays about the same height; third anal spine and anal rays a little lower than dorsal rays; pectoral a little longer than head; ventrals short with a broad rounded tip, 1.33 to 1.5 times in head; depth of the short thick caudal peduncle 2.35 to 2.5 times in head; the short broad caudal 3.25 to 3.3 times in length, its posterior margin almost truncate or gently concave, without elongate marginal lobes; the knifelike caudal spine almost equal to eye, with a short projecting posterior point.

Color in alcohol purplish or brownish black, with a large crescentic or subcrescentic violet pearly spot under and anterior to eye; a pearly or bluish pearly ring around mouth, not continuous above; base of dorsal and anal each with a white line which broadens into a wide orange bar posteriorly, extending nearly to top of last rays; remainder of vertical fins purplish black; caudal pale with a yellow crossbar posteriorly, the hind margin of which is a black line, and beyond this a broad terminal purplish brown band; pectoral blackish; ventrals black, the outer margin a blue line; caudal spine greenish, with a whitish sheath.

Here described from two specimens, 119 and 120 millimeters long, collected on the reef at New Washington, Capiz Province, Panay.

This easily recognized species occurs from the Moluccas to the islands off the western coast of Mexico. It ranges north to Guam and southeast to the Society Islands.

ACANTHURUS CELEBICUS Bleeker. Plate 13, fig. 1.

Acanthurus celebicus BLEEKER, Nat. Tijd. Ned. Ind. 3 (1852) 761; GÜNTHER, Cat. Fishes 3 (1861) 339; Fische der Südsee 1 (1875) 115, pl. 73, fig. B.

Dorsal VIII–27; anal III–25.

The ovoid body much compressed laterally, greatest depth just before anal, 1.77 times in length; the obliquely placed head 3.48 times in length; anterior dorsal profile strongly convex from dorsal to lower level of eye, then concave to tip of snout; the elongate, depressed, pointed snout 4.39 times in head; eye near profile line, 3.6 times in head and almost 3 times in snout; interorbital broad, low, 2.9 times in head, a fourth wider than eye; posterior edge of preopercle inclined about 45°, the angle rounded, obtuse, the depth 1.8 times in head, 1.43 times in snout; mouth small, low, jaws protuberant, 7 obliquely set and laterally imbricate teeth on each side of upper jaw, their round pointed tips denticulate back for about half their length; in lower jaw are 8 larger, broader teeth similarly arranged, their tips wide and irregularly denticulate; dorsal spines short, moderately stout, tip of first one visible, the last one about 5 times in length and almost 1.5 times in head; the dorsal rays are higher and gradually increase in length posteriorly, forming a large broad point at angle, the longest rays 1.1 times in head; anal similar to dorsal in shape, the posterior angle more sharply pointed and extending farther back than the dorsal point; third anal spine 1.8 times in head; the longest anal rays a trifle shorter than the dorsal rays; the broad caudal very slightly lunate, upper margin produced posteriorly into a short sharp-pointed lobe, 2.66 times in length; caudal peduncle 2.23 times in head; caudal spine short, sharp-pointed, 5.8 times in head;

pectoral longer than head, 2.88 times in length; ventrals pointed but not elongate, 1.1 times in head.

Color in alcohol dull violet-brown, darkening toward caudal peduncle, and blackish brown on sides of head; margin of opercle purplish black; lips black, with a white ring starting on upper lip and encircling chin, its color partly suffused with violet; a white spot on preopercle, near its posterior angle; dorsal and anal violaceous black; caudal blackish centrally, with a yellowish crossband forming posterior margin; base of pectoral blackish brown, rest of fin pale, evidently yellow or reddish yellow in life; ventrals violet-brown to violet-black; the white nostrils conspicuous.

Here described from a specimen, 101 millimeters long, from Calapan, Mindoro. This rare and easily recognized species was originally described by Bleeker from a specimen collected at Macassar, Celebes. He later recorded it from Ternate, Amboina, and New Guinea. The British Museum has specimens from the Solomon Islands and Tahiti.

According to Bleeker and Günther, the fin formula is D. VIII or IX–26 or 25; anal III–24.

Since writing the above I have obtained two living specimens from Calapan, Mindoro; the larger one is shown in the colored plate. The amount and intensity of red color behind the head and about the pectoral base vary considerably, according to the light conditions and the state of excitement of the fish. A much smaller specimen is greenish gray anteriorly, the posterior third darker, becoming blackish slaty blue, or in certain lights brownish, sides of head slaty blue, a dusky patch above eye, the mouth encircled by a whitish ring, and a whitish spot near posterior angle of preopercle; the adjacent margin of breast whitish blue; nostrils in a patch of whitish blue and a spot of the same color on lower part of eye; posterior margin of opercle black; behind opercle a blackish red patch extending down to root of pectoral; dorsal and anal dull bluish slate anteriorly, darker posteriorly, the posterior half of both fins with a narrow yellow margin; posterior end of caudal peduncle and central part of caudal blackish; a band of light yellow across posterior margin of caudal, edged posteriorly with a blue line; a stripe of light yellow along lower margin and posterior half of upper margin of caudal; pectoral very pale yellow, ventral dull blue slate.

ACANTHURUS LEUCOCHEILUS Herre, sp. nov. Plate 12, fig. 3.

Dorsal IX–24 or 25; anal III–23.

The depth of the strongly compressed, ovate body about 2 to 2.4 times in length, the greatest depth at origin of anal; the head varies from 3.3 to 3.7 times in length; the dorsal and anterior profile of head varies considerably; it may be a steeply convex uniform curve from dorsal to below eyes, then nearly vertical to upper lip, and lips and mouth projecting, or the snout may be very convex and humplike below eyes and above mouth; the laterally appressed snout 1.3 to 1.44 times in head; eye placed high up, 3.6 to 3.9 times in head, 2.7 to 2.75 times in snout, and 1.07 to 1.28 times in the low, convex interorbital; posterior margin of preopercle begins at or below level of eye and descends very steeply, its broadly rounded angle before a perpendicular from front margin of eye, depth of preopercle 1.8 times in head; mouth very low down, with full projecting lips and protruding teeth; 9 or 10 teeth with broad lobate tips on each side of upper jaw and 10 or 11 similar teeth on each side of lower jaw; dorsal and anal of approximately equal moderate height, angulate posteriorly, first dorsal spine very small; both first and second spines concealed by a covering of thick skin, the spines increasing in length to the ninth, which is 1.68 to 1.87 times in head; the soft dorsal approximately equals the longest spine in height; first anal spine concealed, third 2.4 times in head; caudal deeply lunate with long pointed tips, 2.3 times in length, or tips elongated and ribbonlike, when the fin may be 1.5 times in length; depth of caudal peduncle 2.6 to 3.1 times in head; pectoral approximately equal to head; first ventral ray elongated, with threadlike tip, 1.1 to 1.25 times in head; the knifelike spine has a long sharp point anteriorly and a pointed posterior process, equal to or half again as long as eye.

Color in alcohol uniform blackish brown; snout just above and behind lips black; a broad bluish pearly or pearly white band encircles mouth, or may be only partially developed on upper lip; a similar wide band crosses breast from before anterior angle of gill opening to opposite side and is joined by a band on each side to the ring about mouth; a broad bluish white band encircles base of caudal; pectoral black with a bright yellow transverse bar on posterior margin, which later faded to white; dorsal, anal, and ventral black or brownish black; central part of caudal, back to posterior margin, black, or sometimes with a bluish white lunate band near posterior margin; caudal spine white, its groove with a narrow black margin.

Here described from three specimens, 175 to 200 millimeters long, from Bantayan Island, and a specimen, 196 millimeters long, from Cebu.

A fresh specimen, 186 millimeters long, from Agutaya, one of the Cuyo Islands, was blackish brown above, deep brown elsewhere except cheeks and snout which were reddish brown; lips reddish with a broad bluish white band around mouth, and a wider blackish brown band behind it; a broad bluish white band beginning in front of anterior angle of gill opening and crossing breast to opposite side; a wide bluish white band around caudal base; dorsal and anal were dark brown, the soft dorsal with 3, the anal with 2 dark red lines near margin, alternating with bluish, and a narrow sky blue marginal line; posterior margin of both fins brick red; a deep black line below dorsal base; the caudal was very dark brown with a broad submarginal blue band, posterior edge black, upper and lower margin blue; the pectoral was blackish brown with a bright yellow tranverse bar on posterior third and a broad dusky posterior margin in which the membranes were clear but the rays black; the ventrals were blackish basally and along outer margin, the rest brick red.

λενκσς, white; χετλσς, lip.

ACANTHURUS LINEATUS (Gmelin). Plate 14, fig. 1.

Chaetodon lineatus GMELIN, Syst. Nat. 1 (1789) 1246.

Acanthurus lineatus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 214, pl. 49; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 164; GÜNTHER, Cat. Fishes 3 (1861) 333; Fische der Südsee 1 (1873) 111, pl. 70; DAY, Fishes of India (1875) 203; WEBER, Fische Siboga Exp. (1913) 317.

Acanthurus vittatus BENNETT, Fishes Ceylon (1834) 2, pl. 2.

Hepatus lineatus JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 351; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 270.

Teuthis lineatus SEALE, Occ. Papers Bishop Museum 1 (1901) 108.

Dorsal IX–26 or 27; anal III–25 to 27.

The compressed body elongate ovoid, depth 2 or 2.1 times, head 3.7 to 3.95 times in length; anterior dorsal profile boldly convex, nape appressed and somewhat ridged, snout long, steeply declivitous, 1.3 to 1.4 times in head; eye rather small, 4 to 4.5 times in head and about 3 times in snout; the broad high interorbital 2.85 times in head; mouth very low, with 6 broad lobate teeth on each side of upper jaw; first dorsal spine very short but not concealed, all the spines rather weak, the last one about 1.66 times in head; the rays about as high except those at posterior angle, which are a little more elongate; third anal spine 2.35 to 2.4 times in head, the rays a little lower than dorsal, of similar outline but more sharply angulate posteriorly; pectoral and ventral a little longer than head, ventral with an elongate pointed tip; depth of caudal peduncle twice or about twice in head; caudal spine elongate, deep and shaped like a knife blade, with a short posterior point, 1.9 to 2 times in head; caudal deeply lunate with elongate tips, equal in length or upper one slightly longer, 2.3 to 2.4 times in length.

This beautiful and vividly colored fish is the gorgeous one in a family which is mostly plain colored. The ground color is yellow, the belly blue, with eight to ten blue lines running horizontally or slightly obliquely from cheek or eye to base of caudal and the back; each blue line has a brown band on each side, as wide as the yellow stripes of the ground color between; from anterior margin of eye two similar bands curve forward down snout and around cheek to pectoral base; another goes from anterior dorsal base forward to interorbital where it joins its fellow and forms a median line on snout; some of the lines run out upon posterior part of soft dorsal, rest of fin brown with a black marginal line; 2 or 3 vertical blue lines with brown margins at base of caudal, its anterior half dark brown or blackish brown, posterior half with a broad paler lunate portion, the two colors separated by a curved blue line; pectoral brown at base, sometimes with blue lines transversely, the outer half yellow or paler; ventrals yellow or orange, with the outer part deep blue, usually fading to blackish or dark brown in alcohol; in my specimens the anal is bluish, in some blackish brown with a pale blue marginal line, the base always more or less orange.

No two specimens are exactly alike in color, and there is a wide variation in the arrangement of the stripes of color. The stripes on the body may curve up and back upon the dorsal fin, and the anterior part of the dorsal may be longitudinally barred.

Here described from the following specimens, ranging from 50 to 175 millimeters in length:

Paraoir, La Union Province, 2.
Southern coast of Batangas Province, 1.
Manila, 1.
Sibutu, Sulu Province, 1.
Guam, 1.

Since writing the above I have received a specimen, only 35 millimeters long, from Paoay, Ilocos Norte.

Günther had a specimen labeled "Philippine Islands," and Jordan and Richardson had one from Cagayancillo. This species occurs throughout the East Indies and Polynesia to Tahiti; northward it is not known beyond Guam. In the Indian Ocean it is known from the Andamans, Ceylon, and Zanzibar.

ACANTHURUS ATRAMENTATUS (Jordan and Evermann). Plate 3, fig. 1.

Teuthis atramentatus (by misprint *atrimentatus*) JORDAN and EVERMANN, Bull. U. S. Fish Comm. 22 (1902) (1903) 198; SNYDER, Bull. U. S. Fish Comm. 22 (1902) (1903) 533; HERRE, Fishes of Marcus Island, Occ. Papers Bishop Mus. 2 (1903) 133.

Hepatus atramentatus JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 393, fig. 171; poor figure.

Acanthurus lineolatus GÜNTHER, Cat. Fishes 3 (1861) 366; Fische der Südsee 1 (1875) 112, pl. 73, fig. A; excellent figure; STEINDACHNER, Denkschr. Ak. Wiss. Wien 70 (1900) 493.

Dorsal IX–24 or 25; anal III–23.

The depth is twice, the oblique head 3.45 to 3.7 times in length; body broadly ovoid, strongly compressed laterally, the greatest depth just before origin of ventrals, anterior profile convex from dorsal to below eyes, snout slightly concave; the small mouth low, with 6 teeth on each side of upper jaw; the elongate snout 1.4 to 1.5 times in head; eye 3.4 to 3.7 times in head, 2.5 to 2.6 times in snout; interorbital space rather broad, rounded, moderately low, 2.8 to 3.3 times in head; posterior margin of preopercle oblique, inclined about 45°, the angle beneath or in advance of anterior margin of eye, its depth 2 or 2.1 times in head; opercular margin steeply rounded, nowhere angulate; nostrils close together, the anterior one with a large membranous flap on its posterior margin, the posterior nostril with a more or less evident thin marginal membrane; first dorsal spine very low, concealed in thick skin, the last one longest, 1.7 times in head; anterior dorsal rays a trifle more or less in length than posterior dorsal spine; soft dorsal and anal similar in shape, the fins angulate posteriorly; third anal spine 1.9 to 2.25 times in head, anal rays a little lower than dorsal rays; pectoral a little longer than head; first ventral ray attenuate, equal to head; caudal lunate, upper lobe elongate, running to a sharp point, much longer than head, 2.5 to 2.75 times in length; caudal spine slender, very long pointed, 2.8 to 3.4 times in head.

Color in alcohol uniform brown, the sides dotted with paler, the dots forming irregular longitudinal lines which occur also on the scaled part of vertical fins; dorsal and anal brown to dark brown, with a more or less evident blackish marginal line; pectoral pale brown; caudal paler posteriorly, with a white marginal line; a conspicuous black spot in axil of dorsal and anal. In life the pale dots and lines are blue.

Here described from a specimen, 117 millimeters long, from Sitankai, and two specimens, 104 and 107 millimeters in length, from Puerto Galera, Mindoro. The Bureau of Science collection contains a specimen, 98 millimeters long, collected by me at Sialat Point, Catanduanes. This species is common in the Hawaiian Islands, and ranges throughout the tropical Pacific from Marcus Island to the Samoan and Society Islands.

ACANTHURUS BLEEKERI Günther. Plate 14, fig. 2.

Acanthurus bleekeri GÜNTHER, Cat. Fishes 3 (1861) 335; BLEEKER, Ned. Tijd. Dierk. 1 (1863) 156; KLUNZINGER, Fische des Rothen Meeres (1884) 85; WEBER, Fische Siboga Exp. (1913) 318.

Acanthurus mata BLEEKER, Nat. Tijd. Ned. Ind. 7 (1854) 432; not of Cuvier and Valenciennes.

Dorsal IX, 24 or 25; anal III, 22 to 24.

The ovoid body strongly compressed laterally, broad anteriorly and tapering strongly toward caudal peduncle, its dorsal and ventral outlines alike, its depth 2.2 to 2.26 times, the short blunt head 3.8 times in length, its depth a fifth or a sixth more than its length; anterior dorsal profile high, strongly convex and very steep, forming a thin sharp ridge before dorsal fin; anterior ventral profile more gently and regularly curved; the large circular eye 3.8 to 4 times in head, twice or a little more than twice in snout, and 1.3 to 1.4 times in the broad, elevated interorbital; a smooth bony hump in front of upper part of eye; snout 1.8 to 1.84 times in head; posterior margin of preopercle inclined about 45°, its broadly rounded angle beneath anterior part of eye, its depth twice in head; the small terminal mouth has 9 small teeth on each side of upper jaw, their pointed tips lobate denticulate; teeth of lower jaw shorter, broader, with blunter lobate denticulate tips; dorsal and anal fins regularly rounded and convex, the dorsal spines of moderate size and strength, the first one partially concealed and very short, 7.83 times in head, second spine half again as long, the last one 1.5 times in head; the dorsal rays equal the longest spine, gradually decreasing in length posteriorly, the last three much shorter and the fin angulate posteriorly; third anal spine twice in head, the anal rays similar to the dorsal in height and shape; depth of caudal peduncle 4 times in head; caudal lunate, with sharply pointed lobes, the upper the longer, its length usually 3 times (2.87 to 3) in length; pectoral a little longer than head, about 3.3 times in length; ventral pointed, about 1.25 times in head; the sharp-pointed caudal spine has a short posteriorly projecting point, its length three-fourths an eye diameter.

Color in alcohol uniform reddish brown, with traces of longitudinal lines on sides; 7 longitudinal blue lines on side of head, the upper one running along lower margin of eye, the three upper ones running across snout and uniting with those on the other side; a similar blue band across interorbital, from eye to eye; dorsal and anal darker brown than body, with vestiges of a black spot in posterior axil of each; the other fins same color as body. When fresh the axillary spots were distinct.

According to Bleeker the body color is brownish red with about 30 longitudinal blue lines; the violet-blue dorsal and anal each with 5 to 7 longitudinal yellow bands on the rays, the upper margin violet, each with a black spot posteriorly in the axil; the caudal blackish brown anteriorly, violet-brown posteriorly. These marks have all disappeared in my specimens.

The above description is based upon one specimen, 184 millimeters long, collected by Alvin Seale at Zamboanga, Mindanao, and 6 specimens, 163 to 185 millimeters long, obtained by the Bureau of Science collector G. A. Lopez, at Mariveles, Luzon.

The color of 6 fresh specimens, 150 to 188 millimeters in length, from Agutaya, one of the Cuyo Islands, was chocolate brown, with numerous longitudinal, more or less wavy blue lines on the sides, most distinct and broadest on the ventral half, those on the breast very broad; 7 longitudinal blue lines on side of head, the three upper ones uniting with those of the other side; a wider blue band from eye to eye, across interorbital; the region in front of, below, and behind eye more or less yellow; dorsal with a deep black longitudinal band below its base and a blue stripe above the black one; dorsal and anal chocolate brown, anal with a blue stripe along its base and two longitudinal blue stripes along its middle; the caudal and ventrals were brown like the body, the pectoral blackish basally, the posterior margin clear.

A large specimen, 270 millimeters long, also from Agutaya, has about 33 wavy blue longitudinal lines on body, counting across the body behind the pectoral. We also have two specimens, 190 and 158 millimeters long, from Subic Bay, and three specimens of medium size from the coast of Antique Province, Panay. At the latter place it is very abundant, the Japanese fishermen bringing large quantities from there to Manila.

This distinct species was obtained by Bleeker at Batavia, Java, and Halmahera, and by Weber at Macassar, Celebes. It was also recorded from the Red Sea by Klunzinger. According to Weber it reaches a length of 300 millimeters.

ACANTHURUS DUSSUMIERI Cuvier and Valenciennes. Plate 14, fig. 3.

Acanthurus dussumieri CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 147; GÜNTHER, Cat. Fishes 3 (1861) 335; Fische der Südsee 1 (1875) 112, pl. 72.

Hepatus dussumieri JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 390, fig. 169; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 247.

Teuthis argenteus JORDAN and FOWLER, Proc. U. S. Nat. Mus. 25 (1903) 553.

Teuthis dussumieri JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1903) 477.

Tagalog names, *indongan* and *samara.*

Dorsal IX–24 or 25; anal III–24.

Body deep, ovate, upper and lower profiles nearly evenly convex, or in very large specimens upper profile much more convex or even almost protuberant, depth 1.93 to 2.4 times, head 3.75 to 4 times in length; head deeper than long, nape boldly arched, snout steep or sometimes bulging forward, about 1.85 times in head; eye 4.4 to 4.6 times in head and 2.4 to 3.1 times in snout; interorbital very high, convex, its height 1.2 to 1.25 times eye, its breadth 2.85 times in head; mouth small, low, terminal, with 12 teeth on each side in upper jaw; rear margin of preopercle very oblique, its lower posterior angle beneath anterior portion of eye or even in front of a perpendicular from forward margin of eye; the circular anterior nostril has a thin membranous margin becoming a flap posteriorly; posterior nostril directly behind and much smaller; first dorsal spine very short and concealed in thick skin, the others increasing in length to the last, which is 1.77 to 1.9 times in head; soft dorsal of nearly uniform height, the longest rays 1.5 to 1.6 times in head, the last rays shortened and the fin angulate posteriorly; third anal spine 2.28 to 2.5 times in head, the soft anal like dorsal in shape, the longest ray about 1.75 times in head; the angulate pectoral equals or is a little longer than head; caudal peduncle thick, somewhat compressed dorsally, its depth 3 or a little less than 3 times in head; the large broad caudal lunate, with acute tips, 2.95 to 3.1 times in length; the pointed ventrals extend upon anal, about 1.4 times in head; the large caudal spine varies much in length and thickness, 3 to 7.25 times in head; lateral line concurrent with dorsal profile, descending opposite to or before posterior end of dorsal to caudal spine.

Color in alcohol uniform brown, with a broad pale interocular band beginning behind each eye, and numerous dark brown longitudinal lines on nape, snout, sides of head, and breast; often these lines disappear after a time; the dorsal and anal may each have 3 or 4 longitudinal blue stripes and a basal band of the same color; pectoral dark anteriorly, with a yellow or clear transverse bar on posterior margin.

Fresh specimens were brown, the breast blackish brown, with many longitudinal wavy blue lines on head and body, and a broad bright yellow or orange band from behind eye forward around forehead to behind the other eye; a yellow bar at base of pectoral; the central part of caudal dark dull blue with numerous darker or blackish spots, the upper and lower margins sometimes orange; dorsal orange or yellow, the last few rays dull violet or dusky, with a dull yellow basal band and a blue band above it, a marginal blue or black line, and 3 or 4 more or less well-defined blue longitudinal lines, most evident posteriorly; the yellow anal slaty or bluish dusky posteriorly, with a blue basal band, a blue marginal line, and 3 or 4 blue longitudinal lines; ventral pale yellow, the membrane bluish; caudal spine brown with a black sheath.

The above description is from a specimen, 325 millimeters long, from Olongapo; one, 280 millimeters long, from Linapacan Island, Palawan Province; and one, 330 millimeters long, from Agutaya Island.

A specimen, 310 millimeters long, with a depth of 160 millimeters, was caught by me at Sitankai with hook and line. In life the brown body was marked with blue longitudinal vermiculations, the head sprinkled with a few blue dots; from behind eye a broad lemon yellow band extended forward across eye nearly to middle of forehead, but did not quite meet its fellow; a broad band of yellow on upper lip; the dorsal and anal were each dark lemon yellow with a broad basal band and 4 horizontal parallel stripes of lavender-blue; the pectoral was dark yellow-brown anteriorly, becoming bright lemon yellow posteriorly, with a clear margin; the ventral rays were dark yellow. In alcohol the color markings all disappeared, leaving the fish uniformly dark brown, with but a trace of the ocular band, and some brown vermiculations on the breast.

A female, 320 millimeters long, caught at Agutaya, one of the Cuyo Islands, during the first week in February, 1927, was nearly ready to spawn.

This species is abundant around rocky reefs and is brought to the Manila and Iloilo markets in considerable quantities by Japanese fishermen who catch it by the muro ami net method in the Visayas, especially about Sibuyan, Masbate, Tablas, and Bantayan.

I have examined numerous specimens and find them subject to very considerable variation in shape and color. The yellow interocular band is always present, though sometimes not entire across the frontal region, and separates this species at once from all related species. It is usually crossed by a longitudinal blue bar on its lower part, with another blue bar below it; the blue lines on the snout are wider than those on the body. This fish travels in schools of a dozen or so up to those containing several hundred. It takes the hook freely but is difficult to catch because its mouth is proportionately very small.

Seale and Bean had a specimen from Zamboanga.

Dussumier's surgeon fish is very common in the Hawaiian Islands and undoubtedly is equally abundant in all the intervening island groups between Honolulu and Palawan. The type specimen described by Valenciennes came from Mauritius.

ACANTHURUS MARGINATUS Cuvier and Valenciennes. Plate 3, fig. 2.

Acanthurus guttatus KITTLITZ, Mus. Senckenb. 1 (1834) 195; not of Bloch and Schneider.

Acanthurus marginatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 162; GÜNTHER, Cat. Fishes 3 (1861) 333.

Dorsal IX–24; anal III–22.

Body ovoid, its greatest depth behind ventral fins, 1.91 to 1.93 times in length; anterior profile declivitous, boldly convex from dorsal to level of lower orbital margin, then more or less concave to tip of snout; head 3.33 to 3.57 times in length, placed obliquely, its depth equal to its length; ventral profile uniformly and moderately convex from lower lip to caudal peduncle; the concave snout 1.35 to 1.5 times in head; eye rather high up and anteriorly, 3.25 to 3.375 times in head and 2.25 to 2.5 times in snout, its anterior margin half or three-fourths its own diameter from anterior interorbital profile; interorbital broadly rounded, 3 times in head, twice or a little more than twice in snout; posterior margin of preopercle steeply inclined, forming an angle of about 45°; its lower posterior angle obtusely angled, beneath anterior margin or anterior third of eye, its depth 2 to 2.25 times in head and about 1.5 times in snout; the opercular margin forms a broad bold curve; mouth low, small, with 11 or 12 teeth in upper jaw, their round pointed tips crenulate laterally as well as terminally; dorsal spines of moderate strength, the first one very short but scarcely concealed, its tip more or less evident, the last spine 1.6 to 1.8 times in head; soft dorsal a little higher than last dorsal spine, with an acutely pointed posterior angle; third anal spine 2 to 2.25 times in head; the soft anal equals or nearly equals soft dorsal in height and is of the same shape; depth of caudal peduncle 2.5 to 2.7 times in head; caudal deeply lunate, with elongate pointed tips, the upper the longer, a third or more longer than head, 2.3 to 2.5 times in length; caudal spine slender, with an elongate point and a short posterior point, 2.7 to 2.8 times in head; pectoral a little longer than head; first ventral ray elongate, with filiform tip, its length a trifle more or less than head.

Color in alcohol uniform brown or chocolate brown, the vertical fins with a blackish brown linear margin; pectorals paler than body, the other fins concolorous or darker; the sides of head below level of eye and the body above pectoral base sprinkled with small circular whitish spots; a very deep chocolate brown spot in axil of dorsal and anal; a fine whitish line forms the posterior margin of caudal; two specimens have some curved, nearly vertical pale lines on sides of snout.

Here described from 4 specimens, 77 to 93 millimeters in length, obtained in the China Sea just outside Manila Bay, near Mariveles Point. This species was collected by Kittlitz at Luganor, one of the Caroline Islands, and has not been obtained since. The spots on the head were evidently blue in life, just as described by Kittlitz. My determination cannot be absolute, as I have seen neither authentic specimens nor the original description, but I have little doubt of its correctness. I prefer this disposition to calling it new.

ACANTHURUS NIGRORIS Cuvier and Valenciennes. Plate 4, fig. 1.

Acanthurus nigroris CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 152; WEBER, Fische Siboga Exp. (1913) 317.

Acanthurus nigros GÜNTHER, Cat. Fishes 3 (1861) 332; Fische der Südsee 1 (1875) 110.

? *Acanthurus bipunctatus* GÜNTHER, Cat. Fishes 3 (1861) 331.

Hepatus elongatus JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 389, pro parte; ? JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 270.

Dorsal IX–24 or 25; anal III–23 or 24.

Depth twice, head 3.5 to 3.66 times in length; body ovate, much flattened laterally, anterior dorsal profile convex, declivitous, nearly straight from interorbital space to tip of snout, head small, with elongate snout, 1.4 times in head; eye small, 3.9 to 4.5 times in head and 2.8 to 3.2 times in snout; preopercle broad, deep, with very oblique rear margin, its lower angle rounded, beneath anterior margin of eye or before a perpendicular from eye, its depth about 1.85 times in head; mouth low down, inferior, with 6 broad teeth on each side of upper jaw; interorbital broad, high, convex, 3 times in head; depth of caudal peduncle 2.3 to 2.4 times in head; nostrils close together, anterior one with a thin membranous flap anteriorly and posteriorly, rear nostril elongate with a low membrane anteriorly; first dorsal spine low but not concealed, last one longest, 1.7 times in head; dorsal and anal similar in shape, acutely angulate posteriorly, the longest dorsal rays a little longer than the longest spine, about 1.5 times in head; third anal spine 2.1 or 2.2 times in head, the longest anal ray about 1.85 times in head; pectoral a trifle longer than head; the ventrals extend about to base of second anal ray, a little more or less than head in length; the deeply lunate caudal more than a fourth longer than head, about 2.7 times in length, tips attenuate, upper lobe longer; the caudal spine has a very long point, 2.7 to 2.8 times in head.

Color in alcohol uniformly brown or blackish brown, the lips and the dorsal and anal fins darker than body, with a black spot in the axils of the two fins; the caudal has a whitish line at its posterior margin; pectorals yellowish to brown; ventrals blackish; the margin of the groove in which the caudal spine lies black.

Here described from 3 specimens from Hamilo, Batangas Province, varying in length from 120 to 145 millimeters.

Jordan and Richardson recorded what is probably this species from Cagayancillo. I have two specimens from Guam, 45 and 50 millimeters long, which seem to belong to this species. They have but 5 teeth on each side in the upper jaw.

Elsewhere this species is known from the Pelew and Hawaiian Islands, the New Hebrides, and Samoa, and in the East Indies from Rotti northward to the Karkaralong Islands a little south of Mindanao.

ACANTHURUS MATOIDES Cuvier and Valenciennes. Plate 16, fig. 3.

Acanthurus matoides CUVIER and VALENCIENNES, Hist. Nat. Poiss. **10** (1835) 150; GUNTHER, Cat. Fishes **3** (1861) 330.

Hepatus matoides JORDAN and EVERMANN, Bull. U. S. Fish Comm. **23**[1] (1903) (1905) 387; EVERMANN and SEALE, Proc. U. S. Nat. Mus. **31** (1906) 509; JORDAN and RICHARDSON, Bull. Bur. Fisheries **27** (1907) (1908) 270; FOWLER and BEAN, Proc. U. S. Nat. Mus. **62** (1922) 57.

Teuthis matoides JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1903) 478.

Acanthurus annularis CUVIER and VALENCIENNES, Hist. Nat. Poiss. **10** (1835) 153.

Teuthis annularis FOWLER, Proc. Acad. Nat. Sci. Phila. (1900) 513.

Acanthurus blochi CUVIER and VALENCIENNES, Hist. Nat. Poiss. **10** (1835) 153; GÜNTHER, Fische der Südsee **1** (1875) 109, pl. 69, fig. B.

Teuthis guntheri JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1903) 477, fig. 29.

Hepatus guntheri JORDAN and EVERMANN, Bull. U. S. Fish Comm. **23**[1] (1903) (1905) 388, fig. 168.

Dorsal IX–25 or 26; anal III–24 or 25.

The deep ovoid body strongly compressed laterally, the greatest depth just before anal fin, 1.7 to 1.87 times in length; anterior profile boldly convex from spinous dorsal to tip of snout, head 3.45 to 3.66 times in length, or the head proportionately larger in young specimens; snout long, about 1.25 in head, or 1.5 in young specimens; eye rather large, prominent, 3.5 to 3.8 times in head, 2 to 3 times in snout; in large old specimens it is proportionately much smaller, interorbital rather broadly rounded, not very high, 2.7 to 3 times in head; posterior margin of preopercle steeply inclined; the angle broadly rounded and beneath anterior nostril in well-grown specimens, its depth 1.6 times in head, 1.9 to 2 times in the young; the opercular margin gently and broadly curved; mouth small, low, inferior; nine teeth on each side in upper jaw, their tips long, pointed, crenulate or denticulate back on sides some distance; in young specimens often only 8 teeth are present; dorsal spines slender, the first one very short and concealed in the thick skin, the last one 1.4 to 1.56 times in head; the dorsal rays equal or a little higher anteriorly than the longest dorsal spine, 1.4 to 1.5 times in head, rounded posteriorly; third anal spine 1.92 to 2 times in head; the anal rays a little lower than the dorsal; slightly angulate posteriorly, 1.56 to 1.84 times in head; pectoral a little less than head, its upper rays elongate; the pointed first ventral ray reaches beyond base of third anal spine, 1.2 to 1.25 times in head; caudal more or less lunate, upper lobe elongate and pointed, 2.7 to 2.9 times in length; the depth of the flattened caudal peduncle 2.4 to 2.6 times in head; the short, broad caudal spine has a short posterior projection, its length 3.33 to 3.8 times in head, equal to eye, or twice in eye in young specimens.

In life the color is uniformly brown, with a narrow longitudinal black band on the scaly base of dorsal and anal fins, and a blue band above it; the dorsal has 4 or 5 longitudinal orange bands alternating with blue or lavender bands, the margin with a black line; anal like dorsal; caudal membranes blue, with a blue crossband on posterior margin; pectoral blackish brown, with a broad yellow posterior margin, or may be nearly all yellow; caudal spine pale or whitish, in a black area; a yellowish area about eye.

In alcohol the color is brown to blackish brown, with a more or less distinct wide pale or whitish band on base of caudal; the bands on dorsal and anal disappear entirely; ventrals blackish.

Here described from a specimen, 169 millimeters long, from Honolulu, Hawaii, one from Jolo with a length of 135 millimeters, and two specimens, 79 and 81 millimeters long, from Zamboanga, Mindanao.

A fresh specimen, 185 millimeters long, from Manila Bay, was brownish black, becoming bluish black below; the dorsal with 5 longitudinal pale dull yellow and 4 blue bands; a deep blue band on its base, with a narrow yellow band below it; a black line along margin; the anal had 4 yellow and 4 blue bands; the pectoral was blackish above, the outer third lemon yellow, its inner surface dusky greenish yellow merging into lemon yellow marginally; the iris was pale golden; starting behind eye was a lemon yellow bar which extended forward of eye upon snout, its lower margin a broad dark blue line; the lips were dark blue, with a lemon yellow spot behind their posterior angle; the caudal had an obscure pale basal crossband, the fin deep black posteriorly; the caudal spine and sheath were black.

A specimen, 340 millimeters long, collected in the lagoon at Pearl Bank, has the depth 2 times, the head 3.77 times in the length; snout 1.38 times, eye 5.6 times in head and 4 times in the long, boldly convex snout; nape laterally compressed, ridgelike; the longest dorsal spine twice, the longest rays 1.6 times in head; anal a little lower than dorsal, both fins angulate posteriorly; caudal spine 4.7 times in head, and nearly a fourth longer than eye.

Small specimens have the head differently shaped, sometimes the profile from dorsal to tip of snout forming a steep, almost straight line; a conspicuous whitish or pale band is often present on the basal portion of caudal, its anterior margin sharply defined but merging gradually into brown posteriorly.

In addition to the above, I have examined many living and fresh specimens in various parts of the Islands, and have studied alcoholic specimens ranging in length down to 29 millimeters, as follows:

Mission, Cagayan Province, 1.
Paraoir, La Union Province, 1.
Hundred Islands, Pangasinan Province, 1.
Subic Bay, 1.
Manila, 1.
San Miguel Bay, Camarines Sur Province, 1.
Calapan, Mindoro, 6.
Bantayan Island, 1.
Guimaras Island, 1.
Zamboanga, Mindanao, 1.
Tubigan Island, Sulu Province, 5.
Pearl Bank, Sulu Province, 2.
Sibutu, Sulu Province, 2.
Sitankai, Sulu Province, 1.
Sandakan, Borneo, 1.

This handsome species attains a length of 450 millimeters, and is common about submerged rocky reefs, traveling in small schools like flocks of sheep. Many living specimens from Puerto Galera and Calapan, Mindoro, have been kept under observation in the Bureau of Science aquarium. This species is subject to very considerable variation in shape, the proportions of the eye, and color markings; the caudal spine also varies a good deal in length, but is always relatively stout and short. In alcohol the color markings, including the bands on the fins, disappear entirely as a rule.

The synonymy of this species is in a deplorably confused condition and I make no claim to having clarified the situation. However, my extensive observations have convinced me that the separation of *Acanthurus blochi* or *A. guntheri* from *A. matoides* as distinct species is not justified, and that there is no definite boundary line between those with a large and those with a small eye, those with banded and those with plain vertical fins, and those with convex and those with nearly straight anterior dorsal profile.

This species has been recorded from Zamboanga and Jolo by Evermann and Seale; from Calayan, one of the Babuyan Islands, and Aparri, by Jordan and Richardson; and from Cebu by Fowler and Bean.

Acanthurus matoides was originally described from Oualan, one of the Caroline Islands. It is known from the east coast of Africa, the Red Sea, and Île de France to the north coast of Australia, and the Hawaiian and Society Islands in the South Pacific Ocean.

ACANTHURUS MINDORENSIS Herre, sp. nov. Plate 4, fig. 2.

Dorsal IX–26; anal III–23.

The oblong ellipsoid body very much compressed laterally, depth at origin of ventrals 2.3 times in length; head strongly oblique, its length 3.4 times in total length; anterior dorsal profile convex from origin of dorsal to level of lower margin of eye, the rest concave; the thin concave snout long, 1.38 times in head; eye 4.16 times in head, high up, 3 times in snout; the broad, low, gently rounded interorbital 2.94 times in head and nearly thrice eye; posterior margin of preopercle very steep, the angle very obtuse, rounded, its depth 1.85 times in head, and three-fourths the length of snout; mouth very low down, with protuberant jaws, inclined diagonally downward and forward, with 8 broad teeth on each side in upper jaw, their tips rounded, denticulate laterally for most of their length; teeth in lower jaw broader, not denticulate so far back, 8 or 9 on each side; dorsal spines rather stout, the first one longer than in most species and not concealed, the last one $\frac{7}{9}$ as long as snout and 1.78 times in head; dorsal rays equal last dorsal spine in height, the posterior rays broadly rounded, not elongate; third anal spine much lower, 2.62 times in head; the anal resembles dorsal but is lower, the posterior rays longest, a little more than twice in head; the broad caudal lunate, the lobes not produced, a fifth longer than head, 2.83 times in length; depth of caudal peduncle 2.77 times in head; caudal spine narrow, with a long slender point, equal to eye in length; pectoral shorter than head, 1.16 times in head; ventral pointed, tips not elongate, 0.7 as long as head.

Color in alcohol black, sides of head and breast blackish brown; at base of caudal fin a deep brown ring; all the fins black.

Here described from the type specimen, 170 millimeters long, from Calapan, Mindoro, which has been kept alive a long time in the Bureau of Science aquarium.

I place here a specimen, 184 millimeters long, recently collected at Bantayan Island; dorsal IX–25; anal III–23; teeth above 9, below 10; it is much deeper proportionately, depth

1.88 times in the length, but does not differ materially in other proportions. The color in alcohol is blackish brown, the vertical fins, posterior part of pectoral, and the ventrals black; the caudal is lunate, its central portion black to the posterior margin.

ACANTHURUS PHILIPPINUS Herre, sp. nov. Plate 5, fig. 1.

Dorsal IX–24, sometimes 23; anal III–23 or 24.

Body elongate, ellipsoid-ovoid, greatest depth between ventral and anal fins and 2.16 to 2.2 times in length, head 3.5 to 3.85 times in length; anterior dorsal profile boldly convex, forming a smooth curve from dorsal to mouth, or the region above eyes nearly straight and a bulge before eyes; ventral profile uniformly and strongly curved from mouth to caudal peduncle; snout twice to 2.19 times in head, the circular eye of moderate size, 3.5 to 3.7 times in head and 1.6 to 1.8 times in snout; interorbital rather low, 2.85 to 3 times in head; posterior margin of preopercle steeply inclined, often more or less bowed, the angle obtuse, the depth 2.3 to 2.4 times in head; mouth very small, terminal, a little below median line, lips thin and not prominent; the slender teeth much smaller than in any other Philippine species, with narrow, pointed, finely serrate tips, 10 on each side in upper jaw and 12 to 14 on each side in lower jaw; nostrils small, inconspicuous, the anterior one with a small posterior flap of skin, the posterior one partly concealed by skin; first dorsal spine very low, embedded in thick skin, the last spine twice, down to 1.8 times in head; dorsal rays equal to or usually a little higher than last spine, the posterior rays round pointed; third anal spine 2.2 to 2.6 times in head; anal rays equal to dorsal, posterior rays a little higher, forming an elongate, acutely pointed angle; caudal peduncle thick, somewhat flattened above and below, its depth 2.6 to 2.9 times in head; caudal deeply lunate, tips elongate, the upper one narrow, pointed, and much the longer, 2.4 to 2.75 times in length; pectoral longer than head, 3.15 to 3.4 times in length; ventrals short, broad, 5 to 5.2 times in length; caudal spine about 3 times in head, slender, with an elongate sharp point and a short sharp backward projection.

Color in alcohol dark purplish brown, the vertical fins blackish or deep chocolate; caudal pale brownish yellow; pectoral and ventrals black or deep brown. The caudal was evidently yellow in life, the base more or less dusky.

Here described from 9 specimens, 109 to 143 millimeters in length, from Calapan, Mindoro. The pale caudal and the teeth serve to distinguish this species at once from any other member of the group known to me.

Genus PARACANTHURUS Bleeker

Paracanthurus BLEEKER, Ned. Tijd. Dierk. 1 (1863) 252; Ned. Tijd. Dierk. 2 (1865) 190 and 288; Poissons in Fauna Madagascar, Pollen and Van Dam, part 4 (1875) 97; Arch. Neerl. Sci. Nat. 13 (1878) 51.

Colocopus GILL, Proc. U. S. Nat. Mus. 7 (1884) 279.

Note on *Paracanthurus* Bleeker, FOWLER, in Copeia, No. 155 (June 24, 1926) 139.

This genus is separated from *Acanthurus* by having but three rays in the ventral fins. Only one species of singularly beautiful color and unique marking is known, an inhabitant of the Indo-Pacific tropical waters.

Fowler has called attention to the fact that Bleeker in the publication first cited above wrote *Paracanthurus hepatus* Blkr. =*Acanthurus hepatus* Bl. Bleeker gave no generic diagnosis of his name *Paracanthurus*, but there can be no question as to the species to which he referred.

PARACANTHURUS LAMBDURUS (Gill). Plate 13, fig. 3.

Paracanthurus hepatus BLEEKER, Ned. Tijd. Dierk. 1 (1863) 252.

Colocopus lambdurus GILL, Proc. U. S. Nat. Mus. 7 (1884) (1885) 279.

Acanthurus hepatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 134, pl. 288; not *Teuthis hepatus* L., a West Indian species; GÜNTHER, Cat. Fishes 3 (1861) 341; Fische der Südsee 1 (1875) 115, pl. 75; Challenger Exp., Zoology 1 (1880) Shore Fishes, 52; PETERS, Monatsber. Akad. Wiss. Berlin (1877) 835; DAY, Fishes of India (1878) 206; GÜNTHER, Fishes Challenger Exp., Zool. 1 (1880) 52.

Tao Sug name, *umayi*.

Dorsal IX–19 or 20; anal III–18 or 19; ventral I–3.

Head and trunk much flattened laterally, elongate-ovoid, depth 2.1 to 2.45 times in length; anterior dorsal profile forms a boldly convex curve, ventral profile gentler, flatter, and somewhat irregular; head 3.5 to 3.8 times in length, snout 1.3 to 1.55 times in head; eye variable in size but always small, not quite circular, 3.8 to 5.3 times in head, 2.45 to 3.77 times in snout, and 1.1 to 1.44 times in the high, narrowly convex interorbital space; posterior margin of preopercle very steeply inclined, with a broad curved angle beneath or in advance of anterior margin of eye, its depth 1.7 to 1.88 times in head; mouth low, horizontal, terminal, with 6 broad teeth on each side in upper jaw, their pointed tips irregularly and deeply incised and denticulate-lobate; the teeth of lower jaw have broader tips with deeply incised and divergent lobes; dorsal and anal of moderate height, highest anteriorly, angulate posteriorly; first dorsal spine very short, not concealed, the longest dorsal spine 2.1 to 3.2 times in head, soft dorsal lower than spinous portion, the longest rays 2.5 to 3.75 times in head; anal resembles dorsal in height and shape; depth of caudal peduncle 2.8 to 3 times in head; short caudal more or less emarginate, upper and lower margins with pointed tips slightly prolonged posteriorly, 4.36 to 4.57 times in length; the caudal spine varies from 0.8 an eye diameter to 1.6 times eye, its point very long and sharp; pectoral a little shorter than head; ventral spine longer than rays, 1.8 to 2.25 times in head; scales very small and rough, except on cheeks and snout where they become much larger and form bony stellate plates.

The color when fresh is brilliant ultramarine, becoming indigo about base of pectoral and on basal half of dorsal and anal membrane, duller on snout and paler on belly; from eye a black band goes up and back below base of dorsal to tip of caudal, rapidly becoming much broader to posterior part of dorsal, then narrowing again; beneath third dorsal spine a narrow black band curves downward and backward to tip of lower side of caudal; a broad black area below soft dorsal coalesces with upper and lower black bands, which have a blue island between them; a large brilliant yellow triangle on caudal, its apex extending forward of caudal spine; dorsal spines and rays yellow with a dusky marginal band, wider and becoming black posteriorly; anal like dorsal but spines and rays brownish or black; basal half or two-thirds of pectoral deep blue, its upper margin black, its outer part lemon yellow above, colorless below; ventral spine and rays blue, the membrane orange; eye deep black; the starlike scales on snout and cheek outlined with orange.

In alcohol the colors are similar but less brilliant, the intense blue becoming gray-blue, the other colors less vivid. According to Günther it may be violet instead of blue, the vertical fins yellow with a broad violet margin.

This extraordinarily beautiful fish is here described from 5 specimens, ranging in length from 128 to 192 millimeters, from the following localities:

Elefante Island, Marinduque Province, 1.
Simara Island, 1.
Tablas Island, 1.
Jolo, Sulu Island, 2.

Apparently this species is not abundant. It has been recorded from the Philippines by Günther, who had a specimen collected by the Challenger Expedition at Zamboanga. It ranges from Mauritius through the East Indies to New Britain in the Bismarck Archipelago and the Gilbert Islands. It reaches a length of 250 millimeters.

Genus CTENOCHAETUS Gill

Ctenochaetus GILL, Proc. U. S. Nat. Mus. 7 (1884) 277.
Ctenodon (Bon.) KLUNZINGER, Prosp. Syst. It. Gen. (1831) 109; name preoccupied.

This genus is separated from the other acanthurids by the teeth, which are long, slender, movable, each with the tip dilated and serrated on one side, spoonlike.

Dorsal spines 8 or 9.

Two species are known.

Key to the species of Ctenochaetus.

a^1. Depth 2.3 to 2.4 in length; body dark blue, purplish, or reddish brown, with 9 to 11 longitudinal bluish white stripes; no spots on sides of head .... **C. striatus.**

a^2. Depth 1.8 to 2 in length; body brown with many narrow irregular longitudinal blue lines on sides, or these whitish or disappearing; small spots on sides of head .... **C. strigosus.**

CTENOCHAETUS STRIATUS (Quoy and Gaimard). Plate 13, fig. 2.

Acanthurus striatus QUOY and GAIMARD, Voy. Uranie, Zoologie 2 (1824) 373; Atlas (1824) pl. 63, fig. 3; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 168; GÜNTHER, Cat. Fishes 3 (1861) 334.

Dorsal IX or VIII–26 to 29; anal III–25 to 27.

Depth of the oblong, ovoid, strongly compressed body 2.3 to 2.4 times, head 3.25 to 3.3 times in length; upper and lower anterior profiles evenly and boldly convex; snout 1.77 to 1.88 times in head; eye 2.9 to 3.4 times in head and 1.6 to 1.8 times in snout; posterior margin of preopercle inclined about 45°, its broad angle in advance of eye; its depth 0.2 to 0.4 more than eye diameter; dorsal and anal fins similar in outline, of moderate height, the rays at posterior angle elongate and forming an acute and almost filiform point; dorsal spines weak, the last one lower than the succeeding rays, about twice in head, the elongate posterior rays half again as high; anal rays as high as dorsal; depth of caudal peduncle 2.5 to 2.8 times in head; the deeply lunate caudal 2.47 to 2.6 times in length, its lobes broadly pointed, the upper one a trifle longer than the lower;

caudal spine slender, very pointed, 3.4 to 4 times in head; pectoral a little shorter than head, 3.45 to 3.66 times in length; first ventral ray elongate, with filiform tip, 4.25 to 4.5 times in length.

The color of formalin specimens dark blue, bluish purple, or purplish black, with 9 bluish white longitudinal lines on sides, inclined diagonally downward; often there are traces of one or two more longitudinal lines, or they may be plainly evident; a curved blue line extends from eye forward and downward on snout, and there is another one beneath eye; dorsal bluish black, with narrow blue lines starting at base and running upward, then back longitudinally, about 5 anteriorly, 8 on posterior part; a dark blue margin, and a black spot in axil; anal bluish black with a dark blue margin, the bluish diagonal lines fewer in number and little evident; pectoral colorless; caudal black, with a blue marginal line above and below, the tips of the lobes paler; ventrals bluish black, with a blue marginal line.

In alcohol specimens are reddish brown, the snout, cheeks, and breast paler, the longitudinal stripes nearly white; dorsal, anal, and caudal dark brown, the black axillary spot of dorsal conspicuous; pectoral colorless, ventrals blackish.

The longitudinal lines were probably violet in life.

Here described from 12 formalin and 15 alcoholic specimens, 43 to 60 millimeters in length, collected at Guam, where this species is an important article of food when great schools of this little fish approach the shore. The Bureau of Science collection also contains a specimen, 51 millimeters long, from Mangarin, Mindoro.

This species is entirely distinct from *Ctenochaetus strigosus* (Bennett), with which it has been confused by Günther, Jordan, and others. Specimens of *strigosus* of the same size are altogether different.

CTENOCHAETUS STRIGOSUS (Bennett). Plate 15, figs. 2 and 3.

Acanthurus strigosus BENNETT, Zool. Journ. 4 (1828) 41; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 179; GÜNTHER, Cat. Fishes 3 (1861) 342; KNER, Novara Exp., Fische (1865) 211; GÜNTHER, Fische der Südsee 1 (1873) 116, pl. 79, fig. B; STEINDACHNER, Denkschr. Ak. Wiss. Wien 70 (1900) 494.

Ctenochaetus strigosus JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1903) 480; SNYDER, Bull. U. S. Fish Comm. 22 (1902) (1904) 534; SEALE, Occ. Papers Bishop Mus. 1 (1901) 109.

Acanthurus ctenodon CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 178, pl. 289; GÜNTHER, Cat. Fishes 3 (1865) 342.

Ctenochaetus striatus JORDAN and EVERMANN, Bull. U. S. Fish. Comm. 23[1] (1903) (1905) 398, fig. 174; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 355; EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1906) 97; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 (1922) 57.

Dorsal VIII–24 to 28; anal III–24 to 26.

The ovoid, laterally compressed body is deepest in line with base of ventrals, depth 1.83 to 2 times, head 3.3 to 3.6 times in length; anterior dorsal profile more or less strongly convex, nape appressed and forming a convex ridge; the outline from below and sometimes above eyes forms a straight or nearly straight line to tip of snout; ventral profile much less convex than upper; eye high up, near anterior profile, 3.3 to 3.4 times in head and 2.2 to 2.5 times in the large broad snout, which is 4.88 to 5.1 times in length and 1.33 to 1.5 times in head; the broad interorbital 2.5 to 2.75 times in head; depth of preorbital 1.4 to 1.8 times in head, its posterior margin very steeply inclined, its broadly rounded angle beneath center or anterior part of eye; the small mouth very low down, with thick protuberant lips, and 17 to 19 long slender movable teeth on each side of upper jaw, the tip dilated like a one-sided spoon, serrated on the expanded side only, and set diagonally in jaw; teeth in lower jaw similar in shape, likewise set obliquely, 20 or 21 on each side; first dorsal spine very low, embedded in the skin, second spine short and almost concealed, the other spines increasing in length to the last, which is 1.7 times in head; soft dorsal higher than spinous dorsal, the rays increasing in length to the broadly to acutely angulate and pointed posterior portion, the longest rays 1.2 to 1.3 times in head; anal shaped like dorsal but lower, the posterior rays always sharply angulate or produced to a point, third anal spine 2.1 to 2.33 times in head; the longest anal rays a little shorter than longest dorsal rays; the pectoral exceeds head and may be a sixth longer; ventral elongated to a narrow pointed tip, equal to or a little shorter than head; depth of caudal peduncle 2 to 2.25 times in head; caudal deeply lunate, with narrow pointed lobes which may be nearly equal in length or the upper one elongate and filiform, 2.25 to 2.7 times, rarely twice in length; caudal spine narrow, very long-pointed, knifelike, 2.75 to 3 times in head.

Color in life reddish brown to chocolate brown, with many narrow wavy blue, more or less irregular, longitudinal lines along sides; around eyes, on nape, snout, and cheeks, are small circular brownish red or golden spots; on dorsal are two to several longitudinal blue lines; similar lines may be present on anal; eyes brilliant sapphire.

A living specimen, placed in a small glass vessel, turned light orange yellow, with many fine bluish white longitudinal lines on trunk; the head and breast were smoky gray, sprinkled with pale blue spots; the dorsal and anal were lemon chrome, their posterior tips dusky, and each with a black marginal line; the caudal was pale lemon, with a black marginal line; the ventrals were lemon chrome, the pectoral pale yellow; the eyes did not change. I believe this remarkable color change was due to fright, although the greater intensity of light was a contributory factor.

In alcohol the color varies from pale to blackish brown, the dorsal, anal, and caudal darker than body; a black spot at posterior axil of both dorsal and anal; the blue longitudinal lines on body largely or altogether disappear; if they remain they become pale whitish streaks; the golden spots on head disappear or turn whitish; pectorals paler than the other fins; ventrals dusky or blackish, darkest along outer margin; caudal spine in a brown or blackish sheath.

In the Bureau of Science collection are the following specimens, ranging in length from 35 to 160 millimeters:

Manila, 1.
Nasugbu, Batangas Province, 1.
Calapan, Mindoro, 52.
Puerto Galera, Mindoro, 2.
Sibubu, Camarines Sur Province, 1.
Point Sialat, Catanduanes, 1.
Canigaran, Palawan, 1.
Tubigan Island, Sulu Province, 1.
Sibutu, Sulu Province, 5.
Sitankai, 1.
Guam, 4.

Specimens 60 millimeters or less in length are altogether different from the fish described by Quoy and Gaimard as *Acanthurus striatus*. I have no hesitancy in separating *Ctenochaetus striatus* and *C. strigosus*, as specimens of the same length differ widely in form, bulk, and color. *Ctenochaetus strigosus* is always deeper than *striatus* of the same length.

This species is abundant about coral reefs everywhere and is our commonest representative of the family. In addition to those listed, I have seen specimens from many other localities, both Philippine and foreign. It was reported by Evermann and Seale and by Fowler and Bean from Zamboanga. It is found throughout the tropical Pacific, from the Philippines and New

Guinea to the Hawaiian Islands on the north and the Samoan, Austral, and Society Islands on the south.

Genus ZEBRASOMA Swainson

Zebrasoma SWAINSON, Nat. Hist. 2 (1839) 256.

From *Acanthurus* this genus is separated chiefly by the short spinous dorsal of 3 to 5 graduated spines; the soft dorsal and anal are high, in some species excessively so. In other respects it does not differ essentially from *Acanthurus*. A small genus confined to the Indo-Pacific region.

Key to the Philippine species of Zebrasoma.

a^1. Head and anterior part of body with pale blue or whitish dots, passing posteriorly into fine longitudinal lines; highest dorsal rays equal to head .... **Z. flavescens.**

a^2. Body with 6 broad yellow, white, or reddish brown crossbands, each interspace with several black vertical lines; dorsal rays very high, very much longer than head .... **Z. veliferum.**

ZEBRASOMA FLAVESCENS (Bennett).

Acanthurus flavescens E. T. BENNETT, Zool. Journ. 4 (1828) 41; GÜNTHER, Fische der Südsee 1 (1875) 116, pl. 76; HERRE, Fishes Marcus Island, Occ. Papers Bishop Mus. 2 (1903) 234.

Zebrasoma flavescens JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 [1] (1903) (1905) 397, pl. 59; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 355.

Acanthurus rhombeus KITTLITZ, Senckenb. Mus. 1 (1834) 196, pl. 13, fig. 6; GÜNTHER, Cat. Fishes 3 (1861) 342.

Zebrasoma rhombeum JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 355; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 270.

Acanthurus scopas CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 180, pl. 290.

Acanthurus altivelis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 183.

Acanthurus virgatus VAILLANT and SAUVAGE, Ann. Sci. Nat. (1875) 283.

Acanthurus agaña SEALE, Occ. Papers Bishop Mus. 1 (1901) 110.

Dorsal V–24 or 25; anal III–19 to 21.

Body very deep, compressed, dorsal and ventral outlines equally and evenly convexly curved from a perpendicular at origin of dorsal to caudal peduncle, greatest depth between ventral and anal, 1.4 to 1.8 times in length; the obliquely placed head 2.8 to 3.2 in length, much compressed, pointed, upper anterior profile very steep, oblique to nearly perpendicular from first dorsal to middle of interorbital, the long snout very concave, 1.25 to 1.36 times in head; the circular eye high up, very near profile, 4 times in head (3.66 in small specimens), 3 to 3.15 times in snout (2.75 in young specimens), and a little less than the nearly flat interorbital; jaws produced, equal or the lower one inferior, mouth very low; 8 or 9 lobate teeth on each side of both upper and lower jaws, their lobate tips rounded or more or less acute; anterior nostril about twice the size of posterior nostril, both with marginal flaps; preocular groove very short and steeply inclined downward and forward; dorsal and anal both high; first dorsal spine short to very short, concealed, the other spines successively much longer, the last usually equal to snout, sometimes a little longer; anterior part of soft dorsal much the highest, second to fifth rays longest, remaining rays diminishing in length rapidly, posterior part of fin very low, the longest ray equal to or a little less than length of head; first anal spine very short, concealed, or its tip sometimes visible, third spine usually a fourth or a third less than snout; anal fin much more rounded in outline than dorsal, anterior rays longest, posterior margin of fin nearly vertical, the longest rays much lower than those of dorsal; least depth of caudal peduncle is 3 to 3.3 times in head; caudal a little shorter than head, its posterior margin slightly convex; length of pectoral equals or is slightly less than that of caudal; the angulate, pointed ventral about 1.4 to 1.5 times in head; length of the broad stout caudal spine varies from two-thirds an eye diameter to almost equal to eye, 4 to 5 times in head; before caudal spine is an oblong or ovate patch of hooked bristles; it may be little developed, with short bristles, or may extend almost to tip of pectoral, with very long, coarse bristles.

Color in life dark brown, blackish, or purplish brown, the patch of bristles on side before caudal black or paler than body color, or tips of bristles pale blue; the sides of head and the breast covered with fine pale blue dots; at the region of pectoral and behind origin of dorsal they pass into irregular, wavy, fine blue lines; some specimens have a pale blue bar along middle of side from gill opening to the patch of bristles; pectoral yellowish or pale blue; the other fins uniformly deep chocolate brown, brownish black, or deep purplish brown; caudal spine in a conspicuous white sheath.

In alcohol the color is little changed except that the blue dots and lines often change to whitish, or may disappear, and the color of the pectoral fades.

The above description is based on an examination of many living specimens and also alcoholic specimens, ranging in length from 65 to 129 millimeters, from the following localities:

Calapan, Mindoro, 30.
Bulalacao Bay, Mindoro, 1.
New Washington, Panay, 1.
Estancia, Panay, 1.
Tubigan Island, Sulu Province, 1.
Sibutu, Sulu Province, 1.

A specimen, 53 millimeters long, from Dumaguete, Oriental Negros, is light yellowish brown anteriorly, darker posteriorly, the dorsal light yellowish brown, the anal and caudal dusky brown. A specimen, 46 millimeters long, from Calapan, Mindoro, has six dorsal spines and no caudal spines.

A study of many specimens of *Zebrasoma flavescens* and *Z. rhombeus,* from various localities in the Pacific Ocean, especially Hawaii and Samoa, convinced me that they are merely color variations of the same species. Typical *flavescens* from Hawaii is everywhere chrome yellow, body and fins alike, and may be regarded as an albino variety of the species. The Dumaguete specimen mentioned above seems to be intermediate between the ordinary and the yellow form.

Jordan and Richardson had one specimen of this fish from Cagayancillo, Sulu Sea.

This species is abundant around coral reefs, and occurs from Mauritius, in the Indian Ocean, through the East Indies to Guam, Marcus Island, Hawaii, Samoa, and the Society Islands.

ZEBRASOMA VELIFERUM (Bloch). Plate 11.

Acanthurus velifer BLOCH, Ichtyologie 12 (1797) 106, pl. 427, fig. 1; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 184; GÜNTHER, Cat. Fishes 3 (1861) 344; DAY, Fishes of India (1878) 207.

Acanthurus blochi BENNETT, Proc. Zool. Soc. London (1835) 207.

Acanthurus hypselopterus BLEEKER, Nat. Tijd. Ned. Ind. 6 (1854) 313; STEINDACHNER, Denkschr. Akad. Wiss. Wien 70 (1900) 494, pl. 4, fig. 1.

Zebrasoma hypselopterus JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1903) 479.

Zebrasoma veliferum JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 396, fig. 173; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 356.

Dorsal IV–28 to 32; anal III–24 or 25.

Body strongly compressed laterally, irregularly ovoid in shape, the greatest depth at origin of ventrals or between ventrals and anal, 1.9 to 2 times in length; upper profile descends very slightly posteriorly from origin of dorsal to last third of body, then rapidly to caudal peduncle; ventral outline strongly convex from throat to caudal peduncle; the appressed head 3.15 to 3.6 times in length; profile from dorsal to just below eye very steep and more or less slightly sinuous, that of snout markedly concave; snout about 1.5 times in head (1.47 to 1.62); eye high up, very near profile, 4 to 4.15 times in head, 2.5 to 2.8 times in snout, and about 1.3 times in the low, more or less rounded interorbital; snout produced, mouth very low, lower jaw inferior; 8 pointed teeth on each side in upper jaw, tips and sides lobate for half their length or more; 7 broader blunter teeth on each side in lower jaw; nostrils small, each concealed by a small flap; preocular groove begins immediately in front of eye and is inclined steeply forward, its length about 1.3 times in eye; dorsal and anal very high, the posterior rays much shorter and both fins broadly rounded posteriorly; first dorsal spine very short, concealed, the others successively much longer, the last longer than head, 2.66 to 2.9 in length; anterior dorsal rays very high, fifth, sixth, or seventh highest, 1.9 to 2.3 in length, the others decreasing in height to the last; first anal spine concealed, second and third very much longer, the last 1.4 to 1.8 in head; seventh to tenth anal rays longest, equal to or slighter longer than head; caudal peduncle flattened above and below, its depth 3.4 to 3.6 times in head; caudal broad, a little longer than head, its posterior margin nearly truncate; pectoral equals or is a little shorter than head; the angulate ventral approximately equals snout, 1.4 to 1.6 times in head; the stout, sharp-pointed caudal spine has a knifelike cutting edge, its length nearly equal to eye.

Color of a fresh specimen, 192 millimeters long, was very dark brown, the sides of snout and under chin mottled with white spots which were golden in life; the sides were barred by six broad golden yellow bands, inclined diagonally backward, and soon fading to white; the first band descended from nape, just before dorsal, to opercle, crossing posterior part of eye in so doing, then inclined sharply backward and down to ventral base; the last band crossed from base of last three dorsal rays to the corresponding anal rays; each of the broad brown interspaces between yellow crossbands from the second to the sixth is crossed by 4 or 5 black stripes; the dorsal and anal were nearly black, with numerous nearly vertical paler crosslines, more or less broken into rows of spots, most evident posteriorly, running from near margin inward and backward; pectoral and caudal like body, the last with a narrow whitish line on posterior margin; ventrals purplish black; the caudal spine was in a black spot, its sheath black.

In alcohol the color of the same specimen is as given above except that the golden or white crossbars have turned to whitish or reddish brown, and the crossbands on dorsal and anal have nearly disappeared leaving the vertical fins almost uniform black; the spots on cheeks and chin are but little evident.

In life the crossbands vary from lemon yellow to white; the dorsal and anal may be violet with blue crosslines or spots, or very dark brown with violet bands or rows of spots; any one or all of the fins may be yellow or golden. The color is subject to much variation, but the pattern is always the same and readily recognizable. Some specimens have the caudal pale; others have bluish crosslines on the dorsal and anal.

I have examined the following specimens, ranging in length from 48 to 192 millimeters:

Olongapo, Zambales Province, 2.
Balanacan, Marinduque, 5.
Elefante Island, 2.
Tablas Island, 1.
Bantayan Island, 1.
Agutaya Island, Cuyo Islands, 1.
Jolo, Sulu Province, 1.

Two specimens from an unknown locality, but probably Cebu, were collected by A. L. Day, formerly of the University of the Philippines. In these specimens, 48 and 55 millimeters long, the dorsal and anal are very much higher proportionately than in larger specimens.

This very striking-looking fish well deserves its name of sail bearer. It occurs from India to Hawaii and southeast to Samoa. It reaches a length of 400 millimeters, and a breadth with the extended fins of 350 millimeters.

Genus NASO Lacépède

Naso LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 105.

Monoceros BLOCH and SCHNEIDER, Syst. Ichth. (1801) 180; name preoccupied in Mollusca.

Naseus (Commerson, MS.) LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 105.

Samal name, *kumai tullong*.

Dorsal IV to VI–26 to 31; anal II–26 to 31; ventrals I–3.

In this genus the tail has two, rarely one or three, immovable bony plates on each side, these usually bearing high keen-edged knifelike keels or spines, which may be hooked or curved forward and are very formidable weapons.

The oblong, laterally compressed body usually deep, but in a few species elongate and more or less mackerellike in shape.

The adults of certain species present a most extraordinary appearance through the development of a long to exceedingly elongate slender conical horn on the forehead before the eyes. Other species develop a large convex compressed hump above the snout, which may project beyond the mouth. Those species without a frontal horn or hump have been separated by authors as belonging to the genus *Callicanthus* Swainson, but I do not believe it to be a valid genus.

Mouth small to very small, each jaw with a single row of small to very small, pointed or somewhat rounded incisorlike teeth, smooth or minutely serrate; one dorsal fin, with the soft portion much more developed than the spinous; dorsal spines heteracanthous; that is, the first, third, and fifth are broad and strong on one side, the first, second, fourth, and sixth on the other side; many species have the dorsal and anal rays heteracanthous also; the intestine is long to very long, with many circumvolutions, and four to eight pyloric cæca; air bladder large to very large, forked posteriorly, the branches extending much beyond abdominal cavity; branchiostegals 4 or 5; pseudobranchiæ well developed. Skin thick, tough, covered with minute rough scales which form a sort of shagreenlike covering.

Medium-sized to rather large herbivorous fishes confined to the tropical portions of the Indian and Pacific Oceans, where they range widely. Most of them are dull colored, mostly brownish, but a few species are vividly decorated, the caudal spines being set in patches of ornate brilliance, and one or two species are really very beautiful in coloration. The caudal spines are absent or feebly developed in the young, but soon reach a large size; there is much individual variation in their development, so that specimens of medium size often have the spines much higher than do larger specimens of the same species. Probably no fishes are better armed for defense than some species of *Naso*. A very slight blow from the tail of one of these terrifically armed fishes will cut a man's hand to the bone. In some species the caudal in old males has the upper and lower tips excessively elongated into slender filaments.

The development of the horn, in species provided with this singular protuberance, varies greatly in individuals of the same species. At all stages it imparts an extraordinarily grotesque appearance to the fish. Due to their bizarre physiognomy these fishes attracted the attention of the earliest voyagers to East Indian waters, but even yet they are very imperfectly known. Our knowledge of their development is fragmentary and until the transformations in shape and the changes in the caudal spines due to age are better known our knowledge will continue to be inexact and various species will continue to be confused.

Some of the members of this genus are the largest of the acanthurids, and reach a length of two-thirds of a meter and a weight of 4 or 5 kilograms. The flesh of at least the larger species of the genus is firm, flaky, and well flavored. These fishes are best when baked or roasted, with the skin removed before being served.

Key to the Philippine species of Naso.

- a^1. Two caudal plates on each side.
  - b^1. Forehead with a more or less elongate horn in adult specimens.
    - c^1. Horn extending beyond mouth, its axis passing through center of eye.
      - d^1. Dorsal spines 5; snout below horn steep but not subvertical, 1.5 to 1.7 times eye, about 3 times in head; 33 teeth on each side of upper jaw .... **N. brachycentron.**
      - d^2. Dorsal spines 6; snout below horn subvertical, very short, equal to or less than eye, 4.4 to 5.2 times in head; 24 teeth on each side of upper jaw .... **N. brevirostris.**
    - c^2. Horn not or very rarely extending beyond mouth, its axis not passing through center of eye; about 20 teeth on each side of upper jaw.
      - e^1. Horn very short, its axis below middle of eye; snout below horn moderate, ⅙ more than eye, 2.8 times in head; pyloric cæca 5 .... **N. marginatus.**
      - e^2. Horn long, its axis above eye or through upper third of eye; snout very long, 4.5 to 5.25 times eye, 1.5 times in head; pyloric cæca 7 or 8 .... **N. unicornis.**
  - b^2. No horn on forehead.
    - f^1. A convex and compressed hump upon snout in adult specimens.
      - g^1. Dorsal spines 5; gray or grayish brown, with many small, round, blue or brown spots; caudal truncate, never with elongate lobes .... **N. tuberosus.**
      - g^2. Dorsal spines 6, rarely 5; brown to blackish, with irregular vertical blue lines on sides down to anal; above sprinkled with large blue or brown dots; caudal with elongate lobes. **N. vlamingi.**
    - f^2. Forehead without a hump.
      - h^1. Opercle surrounded by a very broad, deep brown band; tongue blue-black; about 40 minute teeth on each side of upper jaw. **N. genimarginatus.**
      - h^2. Opercle not surrounded by a wide, deep brown band; tongue not blue-black.
        - i^1. Dorsal spines 6.
          - j^1. Caudal plates small, scarcely or not at all keeled; dorsal with 3, anal with 2, pale longitudinal bands; about 20 teeth on each side of upper jaw .... **N. hexacanthus.**

j^2. Caudal spines large, sharp pointed, the plates yellow or red, each set in a large patch of the same color; 14 to 16 teeth on each side of upper jaw.................................. **N. lituratus.**

i^2. Dorsal spines 5; color brown, upper half of body with dark brown circular spots, some on sides of head; caudal spotted like body; 30 teeth on each side of upper jaw........ **N. lopezi.**

a^2. One caudal plate on each side, caudal spine large, very sharp; dorsal spines 4 or 5; 36 to 40 teeth on each side of upper jaw. **N. thynnoides.**

NASO BRACHYCENTRON (Cuvier and Valenciennes). Plate 5, fig. 2.

Naseus brachycentron CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 203; GÜNTHER, Cat. Fishes 3 (1861) 349.

Visayan name, *tudlo-an.*

Dorsal V–28 or 29; anal II–27 or 28; pyloric cæca 4.

Body oblong anteriorly, elongate-ovoid posteriorly, moderately compressed laterally, dorsal and ventral profiles alike and evenly curved from a vertical behind pectoral to caudal peduncle, depth at first or second anal ray 2.72 to 2.84 times in length; head comparatively broad, 3.9 to 4 times in length, the forehead produced into a very long, slender, tapering cylindrical horn which extends far beyond mouth, its axis passing through center of eye, or sometimes through upper third of eye; from eye to tip of horn its length varies from a little more than head to 1.4 times head; length of horn proper from base to tip varies from a little more than head to 1.5 times in head; upper profile below base of horn forms a steep straight line, about 3 times in head; it is a trifle less than distance from eye to first dorsal spine, and 1.55 to 1.68 times eye; anterior ventral profile made abruptly convex by a large hump below isthmus; snout about 1.45 times (1.43 to 1.47) in head; eye high up, 4.8 to 5 times in head, 3 to 3.33 times in snout, 1.85 to 2 times in the broad keeled interorbital, 1.55 to 1.68 times in the profile between horn and tip of lip, and 1.45 to 1.75 times in the distance from eye to first dorsal spine; margin of preopercle begins well below and behind lower margin of eye and descends anteriorly at an angle of 70°, its angle in advance of a vertical from eye, depth of preopercle 1.95 to 2 times in head; the large circular nostrils some distance before middle of eye, the anterior one largest, with a narrow white rim; below them is the preocular groove, inclined diagonally downward and forward, wide and deep but short, 1.2 to 1.6 times in an eye diameter; mouth slightly below median line, with large projecting lips and a prominent groove behind their angle; teeth small, conical, serrulate, about 33 on each side in upper jaw; first dorsal spine

3 to 3.7 times in head; the dorsal rays equal or exceed the spines in height, about 3 in head, fin low, angulate posteriorly; anal spines low, 4 to 5.66 times in head; anal like dorsal but lower, the rays 3.7 in head; caudal peduncle very broad, dorsoventrally flattened, its depth 1.4 to 1.5 times in its own breadth and about 6.5 times in head, caudal fin broad, a little longer than head, nearly truncate, the broad rays pinnate and lobate on posterior margin; pectoral about 1.66 times in head; ventral spine a little shorter than first ventral ray, about 3 times in head; on each side of caudal peduncle two large oval bony plates, the anterior one larger and equal to eye in length; each with a high, keen-edged, knifelike keel, variable in shape, triangulate to nearly rectangular, but not so large as in *N. unicornis;* scales in front of caudal spines and for some distance anteriorly along middle of side much coarser than elsewhere.

Color in alcohol dark purplish plum or olive, nearly black, on head and dorsally, and becoming paler purplish brown to violet-brown on sides and below; throat and breast may be violet-gray; dorsal and anal very dark purplish brown; pectoral deep brown with a white posterior margin; the caudal has more or less yellow or whitish yellow, mostly as stripes between the feather-like rays.

Here described from 3 specimens, 484 to 515 millimeters in length, collected at Bennett Island, Masbate Province.

These fine specimens were remarkably fat, the viscera being as fat-laden as those of a hog ready for butchering. The stomach is very long and bulky, and the intestines are exceedingly elongate and convoluted.

This species is readily separable from *N. brevirostris* by the much greater length of the anterior dorsal profile below the horn, from *N. unicornis* by the very different shape of the cheeks and snout and comparative length of the profile below the horn, and from both by the markedly different caudal, and by differences in shape and relative proportions of horn, eyes, snout, oculo-dorsal distance, etc.

I have no means of knowing positively that my specimens are *Naseus brachycentron* Cuvier and Valenciennes described from Waigiou Island, on the northwest coast of New Guinea, but I prefer this disposition to calling them new and perhaps adding to the already burdensome synonymy of this genus.

After the above was written my assistant, Mr. Montalban, obtained a choice specimen, 405 millimeters long, from Bantayan

Island. The dorsal and anal are narrowly edged with white; the caudal is slightly lunate, truncate when extended.

NASO BREVIROSTRIS (Cuvier and Valenciennes). Plate 5, fig. 3.

Naseus brevirostris CUVIER and VALENCIENNES, Hist. Nat. Poiss. **10** (1835) 204, pl. 291; BLEEKER, Nat. Tijd. Ned. Ind. **5** (1853) 165; Nat. Tijd. Ned. Ind. **9** (1855) 306; GÜNTHER, Cat. Fishes **3** (1861) 349; KLUNZINGER, Fische des Rothen Meeres (1871) 511; GÜNTHER, Fische der Südsee **1** (1875) 121, pl. 79, fig. A, and text figure 5; DAY, Fishes of India (1878) 209, pl. 38, fig. 4; WEBER, Fische Siboga Exp. (1913) 321.

Acanthurus brevirostris JENKINS, Bull. U. S. Fish Comm. **22** (1902) (1903) 481; JORDAN and EVERMANN, Bull. U. S. Fish Comm. **23**[1] (1903) (1905) 401; STEINDACHNER, Sitzungsb. Akad. Wiss. Wien **115** (1906) 1394.

Naseus hoedti BLEEKER, Nat. Tijd. Ned. Ind. **5** (1853) 339.

Visayan name, *tudlo-an.*

Dorsal VI–27 to 29; anal II–28 to 30; pyloric cæca 3 + 2; vertebræ 9 + 13.

Body elongate, oblong-ovate, laterally compressed but the sides often moderately full and rounded, head much flattened laterally, dorsal and ventral profiles equally and evenly curved from a vertical at base of pectoral to caudal peduncle; depth 2.25 to 2.9 times in length; the head varies from 3.6 to 4.5 times in length, usually about 4 times; forehead produced into a stout, blunt or pointed, cylindrical, tapering horn, longer or shorter according to age, its axis passing through center of eye, extending forward horizontally beyond mouth, its length from anterior margin of eye a little more or less than length of head, its true length measured from anterior profile of forehead 6 to 9 times in total length or equal to or greater or more often less than snout measured from eye to tip of upper lip; total length of snout about 1.6 times in head, its anterior profile nearly vertical, its length from base of horn to tip of lip very short, subvertical, equal to or more often less than diameter of eye, 4.4 to 5.2 times in head; eye longer than high, 3.9 to 4.4 times in head and 1.4 to 1.5 times in the broad, elevated, smooth or keeled interorbital; posterior margin of preopercle begins behind middle of eye and is inclined downward at an angle of 60°, its lower angle beneath front margin of eye, depth of preopercle 2 to 2.2 times in head; mouth small, horizontal, on or slightly below axis of body, lips projecting; teeth very small, about 24 on each side of upper jaw, flat, their pointed tips minutely or microscopically serrate; first dorsal spine stoutest, fifth longest, 2.1 to 2.6 times in head; dorsal rays much longer, fin high, increasing in length posteriorly for the first two-thirds, then decreasing slightly, the longest rays 1.7 to 1.2 times in head; second anal spine a little longer than the stouter first spine and a little more than eye in length, 3.7 times in head; anal like soft dorsal, but lower; caudal peduncle strongly compressed, flattened above and below, its depth 5.4 to 6.2 times in head; the caudal varies from convex to slightly emarginate, its length equal to or slightly shorter than head; pectoral 1.35 to 1.4 times in head; the stout ventral spine equals or nearly equals first ventral ray, 1.9 to 2.2 times in head; the broad deep groove in front of eye a little less than an eye diameter in length; the inconspicuous nostrils in a row above it, the anterior one twice as large as the posterior; each side of caudal peduncle with 2 bony plates, the posterior one on base of caudal fin, each with a wide, thin, laterally compressed, high, very keen-edged spine; the spines vary greatly in development, some being hardly more than ridges, but usually they are dangerous weapons, in some cases becoming curved forward into a very sharp hook; the whole body covered with minute hard scales, smooth and velvety when stroked backward, but very rough when one tries to rub in the opposite direction; the anterior scales on cheeks a little coarser, those on top of snout and horn much coarser.

Color variable, usually grayish brown or olive brown, paler below, sides of body more or less covered with many transverse rows of blue dots and blue bars breaking into dots below, sides of head with similar irregularly arranged spots; in some specimens the spots on head pass into nearly longitudinal stripes on horn and forehead; other specimens have the markings of darker brown and some have few or no markings; the vertical lines are usually best developed posteriorly, but in some specimens cover practically the entire side; the membranous posterior margin of opercle yellow; dorsal, anal, and pectorals uniform brown; the dorsal may have one or two faint longitudinal lines of darker brown; sometimes dorsal and anal each have a basal longitudinal line of blue; caudal yellowish or green, or the basal portion deep blue, with a yellow crossband posteriorly and a green or black marginal band, with a fine white line at its extremity; caudal spines brown, their tips clear.

In alcohol the blue markings change to dark brown.

Here described from 13 specimens, 208 to 313 millimeters in length, from the following localities:

Olongapo, Zambales Province, 2.
Calapan, Mindoro, 1.
Bulalacao Bay, Mindoro, 1.
Romblon, 1.
Tablas, 2.
Sibuyan, 1.
Tagapula Island, Samar Province, 1.
Bantayan Island, 2.
Zamboanga, Mindanao, 1.
Sitankai, Sulu Province, 1.

This species varies much in the size of the horn, the development of the caudal plates, and in color pattern, but is readily recognizable by the very short length of the nearly vertical snout between the horn and the mouth. It occurs from Mauritius and Ceylon in the Indian Ocean, to Hawaii, the Gilbert Islands, and Tahiti in the Pacific.

NASO MARGINATUS (Cuvier and Valenciennes). Plate 6, fig. 2.

Naseus marginatus Cuvier and Valenciennes, Hist. Nat. Poiss. **10** (1835) 207; Günther, Fische der Südsee **1** (1875) 122, pl. 83; Seale and Bean, Proc. U. S. Nat. Mus. **33** (1907) 247.

Monoceros marginatus Seale, Occ. Papers Bishop Mus. **1** (1901) 114.

Priodon annularis Cuvier and Valenciennes, Hist. Nat. Poiss. **10** (1835) 223, pl. 294.

Naseus annulatus Bleeker, Nat. Tijd. Ned. Ind. **9** (1855) 304; Günther, Cat. Fishes **3** (1861) 352.

? *Monoceros annulatus* Seale and Bean, Proc. U. S. Nat. Mus. **33** (1907) 247.

Acanthurus annulatus Fowler and Bean, Proc. U. S. Nat. Mus. **62** (1922) 57.

Head and body flattened laterally but lower half of body moderately plump; dorsal and ventral outlines alike, uniformly curved from head to caudal peduncle, the form that of an elongate ovoid, the greatest depth at posterior end of pectoral, 2.3 in depth; top of head very broad, nearly flat, keeled posteriorly, forehead extended forward into a short horn, in my specimen bluntly triangulate seen from above, its axis below middle of pupil, its tip never extending as far as tip of snout, and in my specimen not extending forward more than a third of the length of the mouth; head 3.65 times in length, snout two-thirds as long or 1.5 times in head; anterior profile of snout elongate, inclined at an angle of 50°, its length below horn about 2.85 times in head and a sixth more than eye; the distance from anterior margin of eye to tip of horn 2.3 times in head, the length of the horn proper beyond anterior profile 7.57 times in head or 5 times in distance from eye to tip of snout;

the large eye placed very high up and far back, three and a third times in head and 1.2 times in the wide interorbital; in front of lower part of eye a broad deep curved groove, less than half an eye diameter in length; above it two inconspicuous nostrils, the anterior one with a wide marginal flap and much larger than the posterior nostril; the small terminal mouth is below axis of body, and has a deep groove curving around posterior angle; the narrow, elongate, sharp pointed teeth minutely serrulate, about 20 on each side (18 + 22 in my specimen); the posterior margin of preopercle little evident, inclined at an angle of 60°, its origin below level of eye, its angle obtuse but hardly rounded; depth of preopercle twice in head; first dorsal spine stoutest and longest, 2.14 times in head; the other dorsal spines and the rays progressively lower posteriorly, the fin angulate; first anal spine stout but very short, 6 times in head, second spine a third longer; the anal rays are higher than anal spines but lower than soft dorsal and diminish in height posteriorly; the thick caudal peduncle flattened above and below, its depth and breadth equal, about 6 times in head; caudal lunate, upper margin pointed, a tenth longer than head; the broad blunt pectoral a trifle shorter than snout, nearly 1.6 times in head; the stout ventral spine a very little shorter than first ray, 0.4 the length of head or 2.5 times in head; two small horny plates on each side of caudal peduncle, the second one on base of caudal fin, each bearing a long, low, thin, dull-edged keel; the whole body covered with very fine microscopically scabrous scales, velvety when stroked toward tail, very rough when rubbed in the opposite direction, the scales larger behind eyes, below spinous dorsal, and on top of snout.

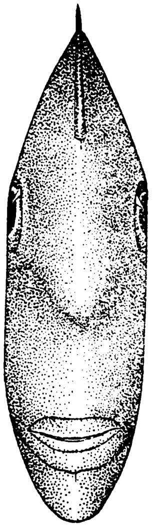

FIG. 1. *Naso marginatus* (Cuvier and Valenciennes); anterior view.

Color in alcohol uniform dusky brown above, merging into gray-brown below; lower lip white; the blackish brown pectoral has a white posterior marginal band; dorsal and anal white edged, dorsal brownish black; anal blackish brown with two pale longitudinal bands; the caudal has a broad whitish yellow band along its extremity; the membranous posterior margin of opercle chocolate brown.

Here described from a specimen, 219 millimeters long, collected at Gato, a rocky islet in the Visayan Sea north of Cebu; dorsal V–28; anal II–27. The longitudinal bands on anal are blue in life; tip of caudal is probably yellow in life. The horn may be longer than in the specimen described, but never extends as far as tip of snout.

I also have seven small specimens, ranging in length from 108 to 130 millimeters, from the following localities:

Calapan, Mindoro, 1.
Zamboanga, Mindanao, 2.
Jolo, Sulu Province, 2.
Bungau, Sulu Province, 1.
Sitankai, Sulu Province, 1.

In these specimens the dorsal has either 5 or 6 spines and 28 or 29 rays; the anal 27 or 28 rays. The caudal peduncle is encircled by a very noticeable broad white ring.

In life a specimen from Zamboanga was greenish olive, dusky at the base of the dorsal, very pale on the breast, with a broad milk white ring on the caudal peduncle; the dorsal and anal were dusky, each with a milk white marginal line, and with two bluish longitudinal bands; the caudal had a wide milk white posterior margin.

Another specimen, 170 millimeters long, from Bungau, Sulu Province, has a prominent hump on the forehead, opposite lower part of eye; this triangulate growth is the beginning of a horn.

Previously recorded from Zamboanga by Seale and Bean; they also named a specimen "20 inches long," from Zamboanga, *Acanthurus annulatus*. The *Priodon annulatus* of Quoy and Gaimard was an immature fish but 2.5 inches long, "deux pouces et demi." It is altogether unlikely that Seale and Bean had *annulatus* or that *annulatus* could be recognized in a specimen 20 inches long. Fowler and Bean described a specimen from Cebu, under the name *A. annulatus*.

This is an East Indian species primarily, although originally recorded from Tongatabu, one of the Tonga, or Friendly, Islands. Bleeker had many specimens, and recorded it from Sumatra, Batol, Java, Bali, Timor, Celebes, Boeroe, Amboina, Ceram, and Goram. It is also known from Guam, the Pelew Islands, and Aneitum, one of the New Hebrides.

NASO UNICORNIS (Forskål). Plate 6, fig. 1.

Chaetodon unicornis FORSKÅL, Descr. Anim. (1775) 63; Icones (1776) pl. 23.

Monoceros biaculeatus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 180, pl. 42.

Monoceros raia BLOCH and SCHNEIDER, Syst. Ichth. (1801) 181.

Naso fronticornis LACÉPÈDE, Hist. Nat. Poiss. 3 (1803) 105, 106, pl. 7, fig. 2.

Acanthurus unicornis SHAW, Zoology 4 (1803) 374, pl. 50; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 402; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 357.

Aspirurus unicornis RÜPPELL, Fische des Rothen Meeres (1828) 60.

Naseus fronticornis (Commerson) CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 191; CUVIER, Régne Anim. Disciples ed. 8 (1836) pl. 72, fig. 2; SCHLEGEL, Fauna Japonica, Poiss. (1842) 129, pl. 69.

Naseus olivaceus (Solander) CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 212; GÜNTHER, Cat. Fishes 3 (1861) 352.

Naseus unicornis GÜNTHER, Cat. Fishes 3 (1861) 348; Fische der Südsee 1 (1875) 118, pl. 78 and 4 text figures; DAY, Fishes of India (1878) 209.

Monoceros unicornis EVERMANN and SEALE, Bull. Bur. Fisheries 26 (1906) 98.

Visayan names, *bakwak, tudlo-an.*

Dorsal V or VI–28 to 31; anal II–26 to 30; pyloric cæca 7 or 8.

The elongate ovate body laterally compressed, but the sides moderately rounded, the greatest depth at first or second dorsal ray, 2.15 to 2.35 times in length; the young much shorter and deeper proportionately; the elongate oblique head 3.45 to 3.6 times in length; snout very elongate, sheeplike, 4.1 to 4.3 times in length, or 1.19 to 1.25 times in head; the length of its upper profile, taken from base of horn, 1.55 to 1.6 times in head and 2.2 or 2.1 times in distance from eye to first dorsal spine; the axis of the long to very long tapering cylindrical horn lies above eye or may be in line with upper third of eye; in very large old specimens it may project beyond tip of snout, but ordinarily it does not extend to it; in my largest specimen the horn is longer than the snout, measured from eye to its tip 4 times in length, 1.1 times in head, measured from anterior profile 1.3 times in head; the prominent eye placed high up and very far back, 4.48 to 5.25 times in snout, 3.43 to 3.25 times in snout below horn, about 1.55 times in distance from eye to first dorsal spine,

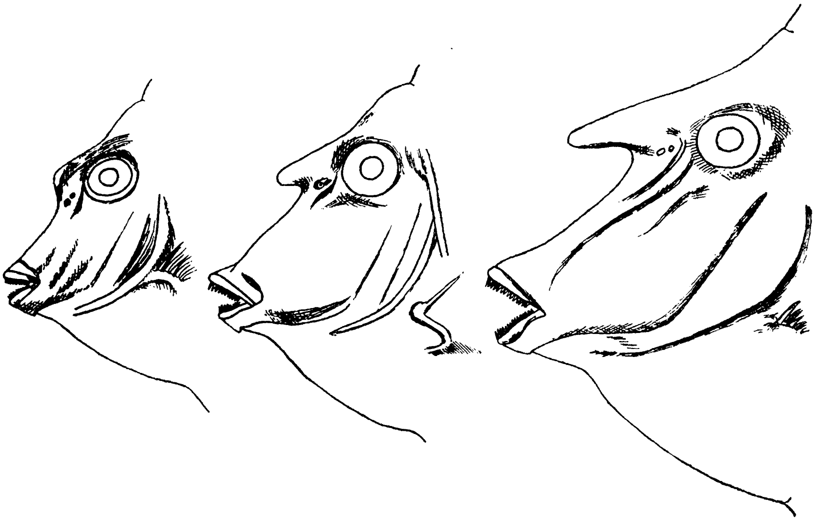

FIG. 2. *Naso unicornis* (Forskål); left lateral view of anterior part of head, to show stages in the development of the horn. (After Günther.)

1.65 times in the broadly keeled interorbital; in other large specimens the horn is much shorter than the snout; preorbital groove wide, deep, less than half an eye diameter in length; above it are the nostrils, the anterior one moderately large with a conspicuous white margin; mouth below axis of body, teeth about 20 on each side in upper jaw, their acutely pointed tips very finely serrate; posterior margin of preopercle begins behind lower part of eye and descends forward at an angle of 50°; the broad rounded angle of preopercle is far in advance of eye, in advance of the junction of snout profile and horn, its depth 1.8 times in head; dorsal spines stout and short in my largest specimen, evidently injured in early life and therefore abnormal, the first one longest, about 3.85 times in head; in a specimen, 95 millimeters long, the dorsal spines are half as long as the head; in two other large specimens the dorsal spines are all about the same length, about 2.3 times in head; the longest dorsal rays equal to or a fourth longer than the spines, becoming slightly and uniformly shorter in the posterior portion; anal spines much shorter, 4.92 times in head; anal rays equal those of soft dorsal; caudal peduncle flattened above and below, a fourth wider than its depth, which is 6.15 times in head; the large lunate caudal a little longer than head; in large old males the tips extend into elongate ribbonlike filaments, and the total length of caudal is then about 1.75 times in length and more than twice head; pectoral 1.75 times in head; ventral spine 2.73 times in head, and a little shorter than first ray; two large oval bony plates on each side of caudal peduncle, the posterior one on base of caudal fin, the anterior one as long as eye; each plate armed with a very high, pointed, keen-edged keel, the tip curved a little forward.

The color in alcohol of one specimen very dark dusky brown on head and upper half of body, passing into pale brown spotted with darker violet-brown below median line, and cream along ventral region from throat to caudal, the fins all yellowish cream except caudal and anterior part of dorsal, which are light brown; dorsal and anal usually orange or yellowish, with longitudinal blue stripes, but these disappear in alcohol.

Other specimens are uniform violaceous gray above, passing into cream ventrally, without spots or markings; when fresh the caudal plates were a beautiful deep violet; the dorsal and anal marked by numerous obliquely longitudinal blue lines; the anal has a dark bluish marginal line; the caudal has a wide band of yellow on posterior margin, with a whitish terminal line.

Here described from a very fine specimen, 445 millimeters long, from Tandubas Island, Sulu Province, and two fine specimens, 336 and 345 millimeters long, from Bantayan Island. The Bureau of Science collection also contains a specimen, 95 millimeters long, which is like Plate 78, fig. B, in Günther's Fische der Südsee. I place here a specimen, 168 millimeters long, from Bungau, Sulu Province; it has no horn but the snout and coloration are characteristic. A short deep specimen, 138 millimeters long, from Honolulu, Hawaii, has the beginning of a horn in a triangular pointed hump before eyes. Its snout separates it at once from all other species. Previously recorded from San Fabian, Pangasinan, by Evermann and Seale, and listed by Günther from the "Philippine Islands" under the name *Naseus olivaceus*.

The shape and development of the horn and of the caudal plates vary greatly with age and have given rise to numerous names applied to various stages of growth.

This curious-looking fish is not often captured by Filipino fishermen, but ranges throughout the Islands. It occurs from the Red Sea to southern Japan and throughout Polynesia, from Hawaii to the Society Islands. It is easily distinguished by the very elongate cheeks and snout, which ordinarily project beyond the horn, even when it is long and well developed.

NASO TUBEROSUS Lacépède.

Naso tuberosus LACÉPÈDE, Nat. Hist. Poiss. 3 (1802) 111, pl. 7, fig. 3.
Naseus tuber CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 214.
Naseus tuberosus GÜNTHER, Fische der Südsee 1 (1873) 123, pl. 80; DAY, Fishes of India (1878) 208.
Monoceros tuberosus SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 247.

Dorsal V–27 to 30; anal II–27 or 28.

The elongate ovoid body laterally compressed, dorsal and ventral profiles alike and uniformly curved behind a line from origin of dorsal to ventrals; with age the anterior profile of snout develops a large, more or less projecting, convex and laterally compressed hump, which extends from eye to end of snout at base of upper lip, upper margin slightly inclined downward before dorsal and extending forward beyond eye 1.5 times the length of eye, then descending nearly vertically to lip; in young specimens the anterior profile describes a boldly convex curve from dorsal to upper lip; greatest depth opposite second anal spine, 2.34 times in length; head longer than deep, about 4.5 times in length; eye high up, 3.23 times in head; mouth small, low down, below median axis, teeth small, not serrate, 18 or 20 on each side of both jaws; the stout dorsal spines short in adults, from 2.5 to 3 or even 4 times in head, but in the young they may be 2 or 2.5 times in head, the fourth spine longest; anterior dorsal rays a little higher than longest dorsal spines, gradually decreasing posteriorly; anal uniformly curved like dorsal, but a little lower; depth of caudal peduncle 3.8 times in head; the wide caudal truncate or very little concave, the tips of its lobes never elongate, or filamentous, a sixth longer than head; the very broad short pectoral 1.3 times in head; first ventral ray 1.8 times in head; caudal spines well separated, small, the keeled spine not very high but sharp and strong.

Color gray or grayish brown, sprinkled everywhere with many small round blue spots, which become brown on dried specimens; dorsal and anal orange to brownish yellow, each with a pale blue basal stripe and a deep blue submarginal line, with a narrow colorless or white margin; pectoral brown with a posterior white marginal band, ventral yellow; caudal gray, edged with white posteriorly, the rays suffused with pink basally; sometimes large specimens have a large, clear, brown-spotted blotch under pectoral.

I have seen no specimens, but Seale and Bean had a specimen, 280 millimeters long, from Zamboanga. It attains a length of over 600 millimeters, and is one of the largest acanthurids. It occurs throughout the tropical Indian Ocean, from Zanzibar, Mauritius, and Ceylon, to Aneitum, one of the New Hebrides, but it is doubtful if it extends farther eastward in the Pacific.

NASO VLAMINGII (Cuvier and Valenciennes). Plate 15, fig. 1.

Naseus vlamingii CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 216; BLEEKER, Nat. Tijd. Ned. Ind. 4 (1853) 472; GÜNTHER, Fische der Südsee 1 (1875) 123, pl. 81; WEBER, Fische Siboga Exp. (1913) 320.

Dorsal VI or V–26 or 27; anal II–27 or 28.

The laterally appressed body elongate-ovoid, dorsal and ventral profiles not equally curved and alike, greatest depth at and behind posterior extremity of pectoral, 2.2 to 2.53 in depth, about 2.5 times in large adults; head more compressed laterally than body, very narrow anteriorly, anterior profile developed so that it is more or less elevated and lengthened until in adults the snout has a convex compressed hump which finally projects forward as far as a vertical from tip of upper lip; length of head a little more than its depth, 3.6 to 4.17 times in length, about 4 times in large adults; snout 1.5 to 1.6 times in head; the distance from eye to anterior tip of hump 1.66 to 1.7 times in head; eye far back, nearly circular, 4.1 to 4.33 times in head (less than 4 times in the young), 2.6 to 2.88 times in snout, and 1.3 to 1.6 times in the broad, elevated, more or less keeled interorbital; the small mouth terminal, with projecting lips, below median longitudinal axis, with 25 or 26 small, slender, pointed teeth on each side of upper jaw, their tips microscopically serrate; a curved groove passes downward and backward behind angle of mouth; origin of preopercular margin below level of eye or behind its lower part; angle of opercle beneath anterior margin of eye or before eye, its depth 2 to 2.25 times in head; the groove before eye curved, prominent, its length equal to or usually greater than an eye diameter, the posterior half very deep, above it are the inconspicuous nostrils, the posterior one very small, the larger anterior one below the posterior one so that they form a diagonal line; first dorsal spine stoutest, all spines equal, or the fourth or the sixth highest, first spine 1.77 to 2.5 times, the longest spine 1.46 to 1.77 times in head; soft dorsal elevated, middle rays longest, longest rays more than half the depth, sometimes equal to head, more often 1.16 to 1.4 times in head; first anal spine 3 times in head, and a little shorter than second; anal like soft dorsal, the anterior rays shorter than all but the very last, the longest rays 1.3 to 1.46

times in head; depth and breadth of caudal peduncle approximately equal, 5.4 to 5.6 times in head; posterior margin of caudal varies from straight to slightly concave, the angles more or less elongate in adults or becoming long and slender filaments, the caudal proper 4 times (less often 3.5) in length; with the elongated filaments included it is about 1.5 times in head and trunk; pectoral 1.3 to 1.46 times in head; ventral spine 1.6 to 1.77 times in head, and a little longer or shorter than first ventral ray; on each side of tail are two oblong rounded plates, the posterior one on base of caudal fin, each bearing a compressed keen-edged spine which may become elevated and a little produced anteriorly, base of anterior spine about two-thirds an eye diameter in length.

This is the most beautifully colored of all the acanthurids, and is distinguished by the richness and elegance of its quiet colors, which are subject to considerable variation, though always of the same general tints and patterns. A breeding female, 317 millimeters long, was very dark brown to blackish, the belly with a golden wash, the cheeks and throat old gold; the sides were covered with irregular vertical lines of a beautiful deep blue, these extending to anal on posterior part of body; under the pectoral was a broad irregular blotch of the same color; the upper part of body sprinkled with large blue dots, which become elongated below and pass into the vertical lines previously mentioned; the belly and breast were thickly covered with small blue dots, these larger and more scattered beneath pectoral; a few blue dots scattered over cheeks; a broad blue band across snout from eye to eye, a blue line beneath and behind eye to upper angle of opercle, and a blue band along margin of shoulder girdle; the dorsal and anal were black with a deep blue margin, blue rays, and a blue band below base of dorsal; the other fins black, the posterior margin of caudal golden.

In alcohol the color is uniform brown, with the blue lines and spots as given above; dorsal and anal violet-brown, pectoral chocolate brown, posterior margin of caudal yellowish brown.

Another specimen was blackish violet when alive, with very dark blue dots above and below on sides, and vertical lines of the same color along middle of body length; the dorsal and anal were blue-black, with deep blue rays, the violet-brown caudal with a white line on posterior margin.

In alcohol specimens vary from brown to violet-brown and deep chocolate brown, the blue spots and lines on sides becoming brown, violet-brown, or blue-black.

Here described from 7 specimens, varying from 150 to 322 millimeters in length, from the following localities:

Puerto Galera, Mindoro, 1.	Zamboanga, Mindanao, 2.
Sibuyan, 1.	Sibutu Island, Sulu Province, 2.
Culion, 1.	

In the smallest specimen the hump on the snout is not developed, but is represented merely by a slight bulging.

This exceedingly handsome fish is distributed throughout the East Indies from Java to Amboina, and also occurs in the New Hebrides and Marshall Islands. Fowler has reported it from the "South Seas."

NASO GENIMARGINATUS Herre, sp. nov. Plate 16, fig. 2.

Dorsal VI–27 or 28; anal II–28 or 29.

The depth of the elongate, broadly fusiform, laterally compressed body about 2.6 times in length, the greatest depth from base of first or second dorsal ray; head longer than deep, laterally compressed toward tip of snout, 4 to 4.14 times in length, its upper profile more convex and less regular than the ventral profile from lower lip to ventrals; snout compressed before eyes, forming a wide long depression in which the nostrils are located, more or less boldly convex, 1.7 times in head; the nearly circular eye not placed high up, 5 to 5.4 times in head, about 3 times in snout and twice in the high, strongly convex interorbital; origin of preopercular margin is behind middle of eye and descends forward at an angle of 60°, its broadly curved angle below anterior margin of eye, depth of preopercle equal to interorbital; mouth moderate, terminal, on median axis of body, with about 40 minute teeth on each side of upper jaw, their elongate pointed tips more or less microscopically serrate; angle of mouth more or less concealed by the conspicuous curved margin of preocular; the diagonally curved groove before eye narrow but very deep and longer than eye; above it there is apparently but a single very large conspicuous white nostril of remarkable appearance, its length a third of an eye diameter, with numerous radial lamellæ; this extraordinary appearance is due to the ravages of parasitic entomostraca, several of which were found in the nasal cavity and preocular groove; by destroying the nasal membranous flaps the two nostrils would be thrown into one; the dorsal spines are all comparatively slender, the first or first and fourth longest, 2.4 to 3 times in head; dorsal low, the longest rays 2.6 to 2.8 times in head; anal spines short, 3.4 to 3.8 times in head, anal lower than dorsal, the longest rays

3 to 3.5 times in head; caudal peduncle very broad, flattened above and below, its depth 6.6 to 6.9 times in head and 1.4 to 1.68 times in its own width; the wide lunate or nearly straight-margined caudal a little longer than head, 3.66 to 4 times in length; pectoral 1.55 times in head, ventral 2.2 to 2.4 times; on each side of caudal peduncle are two large oval plates, equal to or longer than eye, each bearing a large keel which may be very high and sharp-edged, its height then equal to diameter of eye.

The color is very dark purplish brown above and on sides of head, lighter below and merging into gray along ventral and anal regions; opercle inclosed by a very broad chocolate brown band, which extends forward to apex of isthmus beneath chin; the dorsal has golden yellow spots and streaks on the membrane; anal and ventral golden yellow; posterior margin of caudal has a broad greenish yellow band; pectoral brown like body; tongue very deep blue-black or blackish purple, markedly different from that of other members of the genus.

In alcohol the yellow has disappeared and the vertical fins are purplish brown like the body.

Here described from the type, No. 14525, Bureau of Science collection, 452 millimeters long, and the cotype, No. 14526, 426 millimeters long, a spawning female, collected in July, 1926, on a reef near New Washington, Capiz Province, Panay.

Three specimens from 338 to 355 millimeters in length, from a reef near Ibahay, Capiz Province, Panay, have the dorsal 27 to 29; anal 28 to 30. The nostrils are normal for the genus, and the preocular groove is not noticeably deep; the teeth vary from about 35 to 40 on each side of the upper jaw. The breast of one specimen was evidently golden in life; in alcohol it has become yellowish gray. In other respects these specimens do not differ in any essential from the two described previously. A specimen, 395 millimeters long, from Bantayan Island, is plum-colored above, the caudal plates reddish violet, the anal golden.

I also have two specimens from Subic Bay, Olongapo, Zambales Province, Luzon, 255 and 364 millimeters long. The larger specimen has had the dorsal injured at some time, so that only the first and second spines are normal; the sixth one is poorly developed and the others are lacking.

A specimen, 316 millimeters long, from Sibuyan, has 7 dorsal spines.

All my specimens have been partially or wholly eviscerated, so that the number of pyloric cæca cannot be ascertained.

Gena, cheek; *marginatus*, bordered or inclosed.

NASO HEXACANTHUS (Bleeker). Plate 7, fig. 1.

Priodon hexacanthus BLEEKER, Nat. Tijd. Ned. Ind. 8 (1855) 421.
Naseus hexacanthus BLEEKER, Nat. Tijd. Ned. Ind. 12 (1856–1857) 233; GÜNTHER, Cat. Fishes 3 (1861) 355.

Dorsal VI–27; anal II–28.

The elongate ovoid body and head strongly compressed laterally, depth 2.3 times, head 3.75 times in length; dorsal and ventral profiles alike and uniformly curved from mouth to caudal peduncle; anterior dorsal and ventral profiles obtusely convex, depth of head less than its length; front line of snout below eyes descends almost in a straight line to mouth; snout 2.8 times in head; eye moderately large, twice in snout, 3.4 times in head, and 1.2 times in the high arched interorbital; posterior margin of preopercle begins behind pupil of eye, and descends anteriorly at an angle of 60°, its angle broadly obtuse, its depth 2.8 times in head; immediately in front of middle of eye begins a deep groove running downward and forward, its length less than an eye diameter; above it are the inconspicuous nostrils, the anterior one much larger than the posterior one, and with a broad brown marginal flap; mouth very small, terminal, on median axis of body, a thin diagonal groove passing downward and backward behind mouth at its posterior angle; teeth small, pointed, the tips of the upper ones microscopically serrate, the lower teeth blunter and apparently smooth, about 20 on each side of jaw; first dorsal spine stoutest, first and third longer than the others, twice in head; anterior dorsal rays a little shorter, decreasing gradually posteriorly, the last ray a little more than half the first spine; soft anal resembles dorsal but is lower, both fins angulate posteriorly; anal spines both broken in my specimen; caudal peduncle an eighth broader than deep, its depth 6 times in head; caudal lunate with pointed lobes, 3 times in length; pectoral small, 1.37 times in head; the very sharp ventral spine equals first ray in length, 1.7 times in head; each side of caudal peduncle has two small inconspicuous circular plates, the posterior one on base of caudal fin, each with a very low keel, a millimeter to a half millimeter in height; scales on top of snout a little coarser than those elsewhere.

Color in alcohol uniform dusky brown above, becoming paler below; the spinous dorsal has a narrow black margin, the membrane of both dorsal and anal dark brown, with 3 pale longitudinal bands on soft dorsal and 2 on anal, the bands probably blue in life; pectoral uniform brown, caudal dark violet-brown with a paler posterior margin.

Here described from a specimen, 180 millimeters long or 240 millimeters including caudal fin, collected at Mariveles, Bataan Province. This species has been known only from Bleeker's specimens; his description, based on 4 specimens from Amboina, 125 to 198 millimeters long including caudal fin, states that the caudal laminæ are not keeled, and the bands on the dorsal and anal are blue. Later Bleeker had specimens from the following localities, but gave no further description beyond his original one: Batu, one of the Batoe islands; Flores, Timor, and Ceram.

Since writing the above I have received a specimen, 148 millimeters long, from Bantayan Island. It is dark violet-gray above, shading into pallid purplish gray below; the bands on the dorsal and anal are more or less bluish; the caudal plates are scarcely or not at all keeled.

I have no doubt that my specimens are *P. hexacanthus* Bleeker.

Two specimens, 129 and 190 millimeters in length, from Cuyo, have the caudal plates very small, without true keels.

With some doubt I place here a specimen, 214 millimeters long, from Zamboanga. The dorsal is violet-brown, its anterior half with wide pale oblique stripes, which become three longitudinal stripes on the posterior half; the violet-brown anal has a basal longitudinal stripe and another on its lower portion; the stripes on both fins were evidently blue in life. There is a pair of caudal plates, each with a very low keel about a millimeter in height; on the left side of caudal peduncle, about an eye diameter in front of these, is another very small plate with a barely perceptible keel. In other respects it presents no essential difference from typical *N. hexacanthus.*

Dorsal VI–28; anal II–29.

NASO LITURATUS (Forster). Plate 16, fig. 1.

Harpurus lituratus FORSTER, Descrip. Anim. ed. Licht. (1844) 218.

Acanthurus lituratus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 216; after Forster MSS.; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 358.

Aspisurus carolinarum QUOY and GAIMARD, Voy. Uranie, Zool. 2 (1824) 375, pl. 63, fig. 1.

Aspisurus elegans RÜPPELL, Fische des Rothen Meeres (1828) 61, pl. 16, fig. 2.

Prionurus eoume LESSON, Voy. Coquille, Zool. 2 (1830) 151.

Naseus carolinarum CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 208; GÜNTHER, Cat. Fishes 3 (1861) 353; Fische der Südsee 1 (1875) 124, pl. 82.

Naseus carolinarum CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 212.

Aspisurus lituratus RÜPPELL, Neue Wirbelt., Fische (1838) 130.
Monoceros lituratus SEALE, Occ. Papers Bishop Mus. 1 (1901) 113; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 247.
Callicanthus lituratus JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1903) 481; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 404, pl. 60 and fig. 177.
Monoceros garretti SEALE, Occ. Papers Bishop Mus. 1 (1901) 112.

Dorsal VI–29 to 31; anal II–30 or 31; pyloric cæca 8.

Body laterally compressed, depth 2 to 2.2 times in length; head set obliquely, 3.42 to 3.5 times in length, more compressed than body; dorsal profile nearly straight, or may be concave behind tip of snout, slightly convex above eyes; snout thin, three-fourths as long as head, with projecting, rounded muzzle; eye high up, 4 to 4.5 times in head, 3 times or a little more than 3 times in snout, about 1.2 times in the low, broad, nearly flat interorbital; posterior margin of preopercle begins behind middle of eye and inclines downward and forward at an angle of 65°, its lower angle broadly convex and forward of eye, depth of preopercle 1.7 to 1.96 times in head; 14 to 16 small teeth on each side in upper jaw, their smooth flat tips round pointed; first spine the largest, 2 to 2.3 times in head, dorsal spines and rays gradually decreasing in height posteriorly, the fin low and angulate posteriorly; anal resembles dorsal in shape but is lower, first anal spine stouter than second, their height about equal, 3.25 to 3.5 times in head; caudal peduncle low, broad, flattened above and below, its depth 5.2 to 5.6 times in head; the lunate caudal a little longer or shorter than head, 3.27 to 4 times in length, or in males the upper and lower lobes may be extended into greatly elongated filaments; in a specimen, 210 millimeters long, the caudal filaments were 144 millimeters long, and 3.66 times the length of the middle caudal rays; the stout ventral spines equal or exceed the ventral rays, 1.73 to 1.8 times in head; pectoral 1.4 to 1.5 times in head; on each side of caudal peduncle 2 strong horny plates, each with a wide thin high-keeled spine, the posterior one on base of caudal fin; the caudal spines vary with age, becoming strongly curved forward with elongate sharp points, much longer than the basal width; in a young example, 93 millimeters long, the spines are not developed and the basal plates are but little evident; occasionally an adult specimen lacks one or two spines, on either or both sides; the prominent groove in front of eye is always less than an eye diameter in length; the 2 small but conspicuous nostrils close together, one behind the other, directly above the groove.

A specimen, 210 millimeters long, from Olongapo, had the body nearly uniform dusky, the belly suffused with faint golden yellow; a broad band of pale gold extended between eyes and upward and backward from eyes below first two dorsal spines; from lower anterior margin of eye a pale gold stripe curved forward and downward on snout ending behind angle of mouth; a white marginal band on upper and lower lips; each nostril with a white margin; the soft dorsal had a wide white border, with a narrow longitudinal lilac band below it, the rest of the fin black; basal half of anal was blackish, the outer half nearly half, with a black submarginal line; the caudal had a white terminal band, inside this a broader greenish yellow band; the plates on caudal peduncle golden, each set in a large golden patch fading to white marginally, the spines themselves yellow to nearly colorless at tip.

Another specimen, 204 millimeters long, from Ibahay, Panay, was dark olive, verging into greenish yellow on belly; a yellow band curved forward and downward from eye to behind mouth and a very broad greenish yellow band extended behind and above eyes, covering nearly all the interorbital region; the lips were red; the caudal spines were each set in a large golden red patch; the dorsal was black, with a white margin, much broader posteriorly; the anal was greenish yellow, then golden, with a black marginal line and a fine white edge.

A specimen, 240 millimeters long, from Bulalacao Bay, Mindoro, was dusky brown, a little paler below, belly and breast yellowish; the bands above eyes and on snout were golden; the lips were deep brick red; the caudal plates and spines were deep orange red, the plates surrounded by deep yellow; the dorsal was black, the soft dorsal with a bluish white marginal band; a basal band of lilac-blue below the soft dorsal; the anal was largely yellowish merging into orange on outer half, edged with a black line and a narrow marginal stripe of pale lilac.

Here described from 13 specimens, 93 to 245 millimeters in length, from the following localities:

Olongapo, Zambales Province, 2.
Balayan Bay, Batangas Province, 1.
Bulalacao Bay, Mindoro, 1.
Elefante, Marinduque Province, 4.
Tablas Island, 1.
Ibahay, Capiz Province, 1.
Bantayan Island, 3.

I have also seen specimens from the Manila market, Sibuyan Island, and various localities in the south.

This strongly marked species is found on coral reefs throughout the central and southern Philippines, and in some localities is abundant; the only previous Philippine record is that by Seale and Bean of a specimen "16 inches long" from Zamboanga.

I place here two specimens, 80 and 68 millimeters long, collected by R. C. McGregor at Guam and named *Monoceros garretti* by Seale. Each has a broad blue line running along the base of the dorsal and is the true form of *lituratus*, as Schneider's description says "margo interior et extimus pinnarum dorsalium et analis caeruleus;" *garretti*, distinguished by the absence of the blue line at the base of the dorsal, or dorsal and anal, does not seem to me to be a good species.

This fish is widely distributed, occurring from the Red Sea eastward throughout Polynesia to the Hawaiian and Society Islands. It is variable in color but the pattern and general effect are always the same. It reaches a length of 400 millimeters.

NASO LOPEZI Herre, sp. nov. Plate 7, fig. 2.

Dorsal V–31; anal II–30; pyloric cæca 2 + 2.

Body much elongated, fusiform, laterally compressed, mackerellike, the greatest depth at base of second dorsal ray, 3 to 3.3 times in length; dorsal and anal profiles alike, evenly and uniformly curved from snout to tail; head much more laterally compressed than body, 4 to 4.1 times in length; the convexly arched snout 1.56 to 1.6 times in head; eye high up, 4.33 to 4.5 times in head, 2.8 times in snout, and two-thirds as long as the broad, nearly flat interorbital; posterior margin of preopercle begins below level of eye and descends forward at an angle of 50°, its angle beneath nostrils, depth 2.5 times in head; the terminal mouth on the median axis, jaws equal, teeth small, with long, pointed, minutely serrate tips, 30 on each side in upper jaw; the preocular groove nearly horizontal, opposite middle of eye, its length half to three-fourths an eye diameter; the nostrils above it of nearly uniform size, the anterior one with a slight marginal flap; first dorsal spine longest and strongest, 2.4 times in head, the others progressively slightly shorter; dorsal low, angulate posteriorly, the longest rays 3.5 to 3.6 times in head; first anal spine 3.4 to 4 times in head, second spine shorter and slenderer; anal rays like dorsal in shape and height; depth of caudal peduncle 5.2 to 5.6 times in head, less than eye, and less than its own breadth; caudal fin slightly lunate, the lobes more or less pointed, longer than head, 3.5 to 3.8 times in length; pectoral rather blunt, 1.6 to nearly 1.7 times in head; ventral spine and first ray about equal in length, about 2.5 times in head; on each side of caudal peduncle are two ovate bony plates, the posterior one partly on caudal fin, the anterior one well separated, each bearing a thin sharp-edged elevated keel, rounded in outline or the anterior margin vertical.

Color in alcohol rich brown or violet-brown above, paler on sides, grayish brown below and gray on throat; one specimen has the cheeks bright silvery; upper half of body thickly sprinkled with dark brown circular spots, not many below the median line, a few on opercles and preopercles; a very large irregular golden yellow blotch behind head and partly covered by pectoral; caudal thickly covered with brown spots like those on body, with a broad greenish yellow posterior marginal band, with a terminal white band; spinous dorsal covered with large violet-brown circular spots and irregular pale streaks; membrane of soft dorsal deep violet, or spotted like spinous dorsal; that of anal violet-brown, apparently with paler stripes; eye golden. In life the spots on sides and caudal were probably violet and the ventrals and pectorals were also violet, with a yellow bar on pectoral base.

Here described from the type, No. 14084, Bureau of Science collection, 370 millimeters long, and a cotype, 310 millimeters long, both from Ambil Island, in the China Sea southwest of Manila Bay; and a specimen, 386 millimeters long, from Bantayan Island. Both the specimens from Ambil Island were heavily infested with a nematode worm.

From Bulalacao Bay, on the southeastern coast of Mindoro, I have received a specimen, 156 millimeters long; dorsal V–29; anal II–28. The color is violet-gray above, paler below with a faint violet longitudinal bar along the middle; violet-brown spots thinly sprinkled over upper half; cheeks silvery; soft dorsal and anal are both edged with white and each has two longitudinal pale stripes, the spinous dorsal spotted and streaked with violet; posterior part of caudal greenish, edged with white.

Named for G. A. Lopez, collector of fishes for the Bureau of Science.

NASO THYNNOIDES (Cuvier and Valenciennes). Plate 7, fig. 3.

Axinurus thynnoides CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 221, pl. 293; CUVIER, Règne Animal, Disciples ed. 8 (1836) pl. 74, fig. 3.

Naseus thynnoides BLEEKER, Act. Soc. Sci. Indo-Neerl. 2 (1857) Amboina, 61; GÜNTHER, Cat. Fishes 3 (1861) 355.

Dorsal IV–V, 28 or 29; anal II–28 to 30; pyloric cæca 3.

Body much elongate, almost fusiform, laterally compressed, depth 2.8 to 2.9 times in length; the blunt or somewhat pointed head longer than deep, 3.75 to 4 times in length; anterior dorsal and ventral profiles almost equally curved, the line from first dorsal to mouth uniformly and moderately convex, snout 2 to 2.25 times in head; the large circular eye placed well below profile, 1.5 to 2 times in snout, 3.3 to 3.9 times in head; interorbital high, convex, about 1.2 times eye, a rather prominent bony hump before upper part of eye; posterior angle of preopercle below middle of eye or sometimes anterior margin of pupil, its depth 3⅓ to 3⅔ times in head; posterior margin of preopercle beginning behind middle of eye and inclined downward and forward at an agle of 60°; the small terminal mouth below axis of body, its angle covered by the projecting preocular; teeth minute, 36 to 40 on each side of upper jaw, 26 to 30 in lower jaw; spinous dorsal variable, with either 4 or 5 spines, often irregularly developed, first spine strongest, first, fourth, and fifth (if present) usually equal in height, 2.7 to 2.8 times in head; soft dorsal higher than spinous, very little less in height posteriorly, angulate behind, the longest rays 2.2 to 2.4 times in head; anal spines short, 2.2 to 4 times in head; anal rays a little lower than soft dorsal, about 3 times in head; caudal peduncle constricted, its depth 6.8 to 7.2 times in head, its breadth a third greater than its depth; caudal more or less blunt, its upper lobe somewhat pointed, 3.5 to 3.6 times in length; on each side of base of caudal fin is an oval bony plate bearing a thin, very sharp, horny, platelike spine, which may be very large and more or less hooked forward; the size of these spines varies greatly in fishes of the same length; the ventral spine and first ray approximately equal in length, 2.7 to 2.8 times in head; pectoral rather small, a little more or less than 1.5 times in head; the groove in front of eye deep, little curved but nearly horizontal, its length 0.9 an eye diameter; nostrils inconspicuous, about equal in size.

Color uniform pale olive-brown above, merging into brownish gray on sides, breast and belly paler; dorsal and anal dark brown, each with oblique yellow lines running upward and backward; caudal and pectoral both yellow; in my smallest specimen the color is dark violet-brown above, gray below; dorsal, anal, and caudal violet-brown to violet-black.

In alcohol the body color changes but little; the yellow lines on dorsal and anal fins are blackish, more or less vaguely marked with oblique lines; the yellow disappears from caudal and pectoral.

Here described from six specimens, 145 to 336 millimeters in length, one from Bulalacao Bay, Mindoro, two from Tablas Island, and three from Ibahay, Capiz Province, Panay. I find the teeth, under the compound microscope, more numerous than given by Bleeker, who gives them as 26 above, 20 below. According to him there are three blue lines on dorsal and anal; their exact color undoubtedly varies in different individuals. A fine specimen, 220 millimeters long, from Tablas Island, is purplish gray, dark above, pallid below, sides of head slate purple, posterior margin of caudal whitish. I also have two typical specimens from Mariveles, near the entrance of Manila Bay; they are 99 and 140 millimeters in length.

Two small specimens from Dumaguete, each 68 millimeters in length, show no trace of any caudal plates.

Cuvier and Valenciennes had a small specimen from New Guinea, and Bleeker three still smaller ones from Amboina. Günther does not state the size of his specimen, which was also from Amboina.

As the name indicates, this species has the shape of a scombroid fish.

ZANCLIDÆ

MOORISH IDOLS

The oblong or suborbiculate body is deep, the back much elevated, strongly compressed laterally, the skin firm, covered everywhere with minute, rough, shagreenlike scales which extend upon the basal portion of both dorsal and anal. The snout tubular, mouth small, with long, slender brushlike teeth; no teeth on palate; the bones of top of head thick and solid; the interorbital may be smooth or with a hump or conspicuous horn over each eye; a backward-curved spine may be present or absent above angle of mouth. Dorsal single, spines 7, the third long to exceedingly elongate and threadlike, the remaining ones successively shorter; anal similar to soft dorsal, long, the anterior rays produced; anal spines 3, caudal peduncle not armed, the broad caudal fin lunate; pectoral short, ventrals pointed. Intestine long, with about 14 pyloric cæca; air bladder large; branchiostegals 4; vertebræ 9 + 13 = 22.

Jordan and Evermann state, "interspinal bone projecting before dorsal;" there is no projecting bone, and dissection reveals that the interneural is expanded forward to form a part of the high narrow predorsal ridge, covered with thick skin; they also say that there is a small antrorse spine before the anal, but my specimens show none. The first anal interhæmal spine is dilated and extends forward nearly to the somewhat distant anus, but it can hardly be called an antrorse spine, and is likewise covered with thick tough skin.

A small family of ornately colored fishes of bizarre shape, confined to the tropical parts of the Indian and Pacific Oceans, ranging northward to southern Japan. The Zanclidæ have an exaggerated chaetodont shape, and their habits are similar to those of the butterfly fishes, but their affinities are more with the Acanthuridæ. In the system they occupy a position between the Chaetodontidæ and the Acanthuridæ.

The strange name of Moorish idol was invented by Renard, who published in 1718 his natural history of the rarest curiosities of the Indian Sea, based upon figures and information obtained by Balthasar Coyotte, governor of Amboina. Some of the Molucca islanders made this extraordinary little fish the object of their superstitious reverence. If they happened to catch one they made obeisance, showed other signs of respect, and placed it back in the sea. The early travelers in the Orient applied the name of Moor to all Mohammedans, so that even to-day we have the fantastic appellation of Moro or Moor applied to Mohammedan Malays, though the Moors are really Caucasian natives of Morocco or their Arab conquerors.

Genus ZANCLUS (Commerson MS.) Cuvier and Valenciennes

Zanclus (Commerson MS.) LACÉPÈDE, Hist. Nat. Poiss. 5 (1804) footnote under *Chaetodon*, misprinted *Zanchus;* nonbinomial.

Zanclus (Commerson) CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 77.

The characters of the single genus are included in the family diagnosis. Only two species are known, confused by most authors.

Key to the species of Zanclus.

a^1. A strong backward curved spine above angle of mouth...... **Z. canescens.**
a^2. No spine above angle of mouth; adults nearly always with a spine or hump over each eye...... **Z. cornutus.**

ZANCLUS CANESCENS (Linnæus). Plate 8.

Chaetodon canescens LINNÆUS, Syst. Nat. ed. 10 1 (1758) 272.
Zanclus centrognathus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 397.
Zanclus canescens GÜNTHER, Cat. Fishes 2 (1860) 493; BLEEKER, Atlas Ichth. 9 (1878) 366, pl. 4, fig. 3; WEBER, Fische Siboga Exp. (1913) 325.
Zanclus montrouzieri THIOLLIERE in Montrouzier, Fauna Woodlark (1856) 168.
Zanclus ruthiae BRYAN, Occ. Papers Bishop Mus. No. 4 2 (1906) 22, fig. 2.

Dorsal VII–38 to 41; anal III–32 to 35.

Body very deep, short, laterally compressed, back greatly elevated, breast and belly equally extended and semicircular, depth equal or almost equal to length; head compressed, its depth greater than its length, not drawn out into tubulate form anteriorly, 2.4 to 2.6 times in length, distance from posterior margin of preopercle to tip of snout 1.7 to 1.8 times in head; profile from origin of dorsal to below eyes a bold, very steep curve (undulate in one specimen), snout concave, short, deep, 1.66 to 1.8 times in head, not greatly extended beyond anterior dorsoventral profile; preorbital with a strong, sharp backward-curved spine above angle of mouth, its anterior base with two or three small pointed teeth before spine; eye high up, 2.85 to 3 times in head, 1.7 to 2 times in snout; the convex interorbital equals or is narrower than eye, without a horn or hump over eye; first and second dorsal spines very short, stout, acute; the very elongate third spine is prolonged into a thread and may be twice as long as head and body together; soft dorsal and anal shaped as in *Z. cornutus*, but third anal spine higher, 2 to 2.4 times in head; caudal peduncle 2.5 to 2.8 times in head; caudal slightly lunate, upper lip more or less extended, about 1.1 times in head; pectoral equals caudal; first ventral ray elongate, its tip filiform, equal to or a tenth longer than head.

Color in alcohol brown or brownish yellow, opercles and anterior half of body below level of eye bright silvery; a black band extends from spinous dorsal and above eyes to breast and behind anus, including all of eye except anterior margin; a narrower black band extends from tip of anterior dorsal rays to lower margin of anterior two-thirds of anal; caudal blackish with a wide lunate pale yellowish or clear posterior marginal band; tip of snout and chin and lips black; ventrals and third dorsal spine black, the free tips of most of the dorsal rays and the posterior third of the anal rays white or yellowish.

Here described from two specimens, 61 and 52 millimeters long, from Legaspi, Albay Province, and two specimens, 50 and 52 millimeters long, from the Manila market. A comparison of this material with specimens of *Zanclus cornutus* of equal or smaller size leaves no doubt as to their specific difference. The snout and body are markedly different in shape, and the presence of the spines on the snout of *Z. canescens* is a character of which there is no trace in *Z. cornutus.* Weber had specimens, 70 and 80 millimeters long, which still showed the characteristic preorbital spine and lacked the frontomaxillary looped band typical of *Z. cornutus.*

This species occurs from Celebes and the Moluccas to the Santa Cruz Islands and Hawaii. A specimen was found in the stomach of a *Coryphaena* caught in 1° north latitude, 75° east longitude, Paris meridian.

ZANCLUS CORNUTUS (Linnæus). Plates 9 and 10.

Chaetodon cornutus LINNÆUS, Syst. Nat. ed. 10 1 (1758) 273; BLOCH, Ichtyologie 6 (1758) 52, pl. 200, fig. 2.

Zanclus cornutus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 78, pl. 177; GÜNTHER, Cat. Fishes 2 (1860) 493; THIOLLIERE, in Montrouzier, Fauna Woodlark (1857) 167; DAY, Fishes of India (1878) 111, pl. 28, fig. 4; BLEEKER, Atlas Fishes 9 (1878) 77, pl. 366, figs. 1 and 2; JORDAN and EVERMANN, Fishes N. and Mid. America 2 (1898) 1687; JORDAN and RICHARDSON, Bull. Bur. Fisheries 27 (1907) (1908) 269; WEBER, Fische Siboga Exp. (1913) 325.

Zanclus canescens JORDAN and FOWLER, Proc. U. S. Nat. Mus. 25 (1902) 549; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23[1] (1903) (1905) 382, pl. 57.

Visayan name, *kalmin-kalmin.*

Dorsal VII–39 to 41; anal III–31 to 33.

Body very deep, short, oblong, laterally compressed, back elevated, depth 1.12 to 1.3 times in length; head compressed, drawn out into a tubulate pointed snout, 2.25 to 2.5 times in length, its depth less than its length; from posterior margin of preopercle to tip of snout 1.3 to 1.4 times in head; profile from origin of dorsal to eyes descends obliquely and very steeply; interorbital concave, with a hump or a pointed, outward-curved horn above each eye, the size of the horn varying greatly; below eyes snout very concave, with long, conical, produced jaws, projecting far beyond anterior dorsoventral profile, 3.1 to 3.5 times in length and 1.35 to 1.45 times in head; mouth small, jaws equal, with long slender pointed teeth; eye high up, 4 to 5 times in head, 3 to 3.6 times in snout, proportionately larger in the young; the concave interorbital equals or slightly exceeds eye, measured above eye, and is less than eye measured in front of eye; first and second dorsal spines very short, stout, acute; third spine long to exceedingly elongate with thread-like tip, sometimes 1.5 times the length of head and body; fourth to seventh spines successively much shorter, fourth less than half as long as third, seventh longer than head; dorsal rays high at first, the first and second longer than head, the others diminishing rapidly in height, those of posterior half very short; first and second anal spines very short, strong, acute, third 2.5 to 3 times in head; anal rays high anteriorly, posterior half of fin very short, second to fourth rays 1.4 to 1.8 times in head, the others successively much shorter; caudal peduncle strong, 3 to 3.3 times in head; caudal rather broad, its posteror margin nearly truncate or very slightly lunate and upper tip the longer, its length 1.2 to nearly 1.5 times in head; pectoral shorter than caudal, 1.43 to 1.5 times in head; the pointed ventral 1.5 to 1.7 times in head.

In life the body is bright canary yellow (less often yellow shading into white, rarely pearly white), with two wide black or dark brown crossbands; the anterior one extends from first or second dorsal spine to supraorbital horns and down to breast and behind anus, including ventrals, its anterior margin bounded by a blue or pearly white stripe; on lower half are two blue lines, one from origin of ventrals to gill opening and up behind eye to median line before first dorsal; the second blue line begins behind anus, goes up to base of pectoral, passes forward of this and up to origin of dorsal; a third line extends from upper margin of eye up to median line of head where it meets its fellow in a long acute angle; from upper anterior margin of eye a blue line curves up behind base of supraorbital horn and curves down to the middle of the space between the horns to meet its fellow; the posterior black band extends from tip of anterior dorsal rays across body to lower margin of greater part of anal, widest below, a blue line extending across its posterior part; a wide black band covers most of caudal, bounded posteriorly by a crescent-shaped blue or white band, the wide margin yellowish.

A black or deep brown band extends from interorbital space down snout to its tip; a stripe passes from it down side of snout and curves up back on tip of snout, inclosing a roughly triangular yellow area, the stripe margined below by a pearly white or bluish line; a large black or deep brown spot on lower lip and jaw; pectorals pale yellowish, ventrals very dark brown or black; soft dorsal and anal edged with black.

In alcohol the yellow fades to white or very pale brownish yellow, and the blue also usually turns to white; the dark cross-bands usually become paler than in life.

In addition to observing a number of living specimens in the Bureau of Science aquarium, I have examined the following alcoholic specimens, ranging in length from 47 to 150 millimeters:

Basco, Batan Island, Batanes Province, 1.
Olongapo, Zambales Province, 3.
Monja Island, just outside the entrance to Manila Bay, 2.
Mariveles Bay, Bataan Province, 1.
Calapan, Mindoro, 1.
Bulalacao Bay, Mindoro, 2.
Elefante Island, 7.
Simara Island, 1.
New Washington, Panay, 2.
Estancia, Panay, 2.
Tagapula Island, 2.
Carnasa Island, 2.
Clarendon Bay, Balabac, 1.
"Philippines," 7.

My specimens from Monja Island, a male 143 millimeters and a female 133 millimeters long, collected on April 23, 1922, were ready to spawn.

This striking-looking and gorgeously colored little fish, of stately demeanor and grotesquely comical countenance, is common on rocky reefs throughout the entire Philippines. The only previous Philippine record is by Jordan and Richardson, who had specimens from Fuga Island, north of Luzon, and Cagayancillo, in the Sulu Sea.

My smallest specimens, 47, 56, 57, 61, and 62 millimeters in length, have the head, snout, form, and color markings identical in every respect with those of the largest specimens. The horns above the eyes do not begin to develop until the fish is about 75 millimeters long, and their development varies greatly in adult specimens of the same size. One specimen 130 millimeters long has no horns, while other specimens two-thirds as large have large horns. The presence or absence of horns above the eyes is therefore not a specific character.

Even the smallest specimens are entirely distinct from *Z. canescens,* which cannot be considered as the young of *Z. cornutus.*

This species has an enormous range, occurring from Zanzibar and the east coast of Africa to the Hawaiian, Samoan, and Tonga Islands, and on eastward to the Revillagigedo Islands off the coast of Mexico. Cuvier and Valenciennes had specimens, 250 millimeters in length, but state that it becomes larger.

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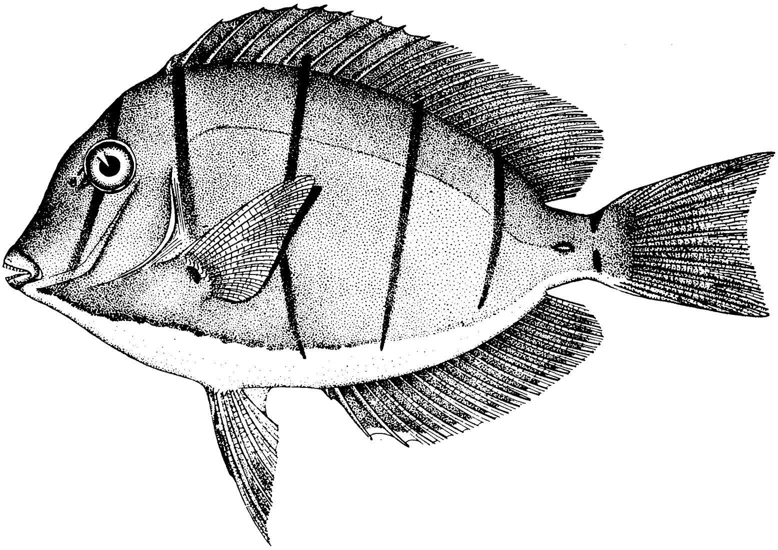

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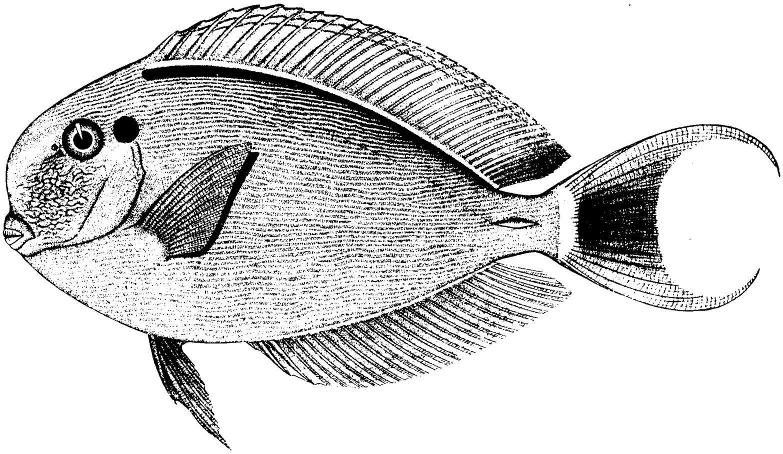

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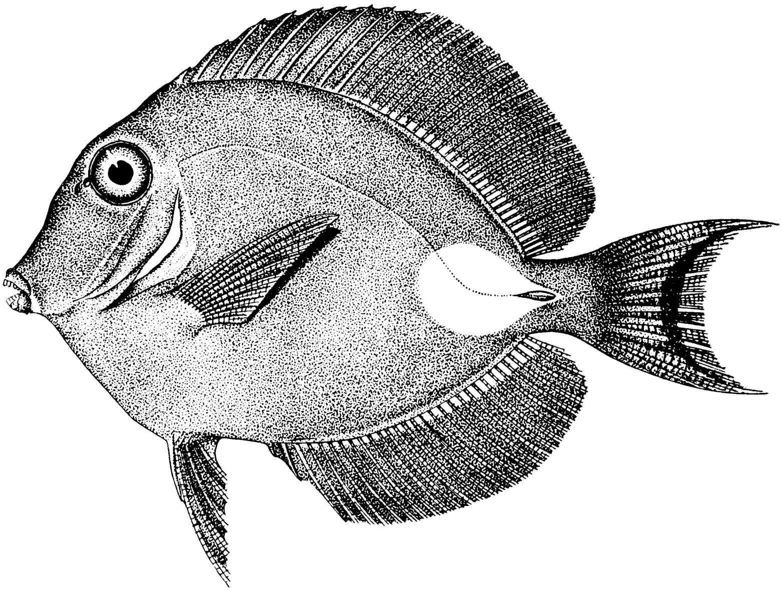

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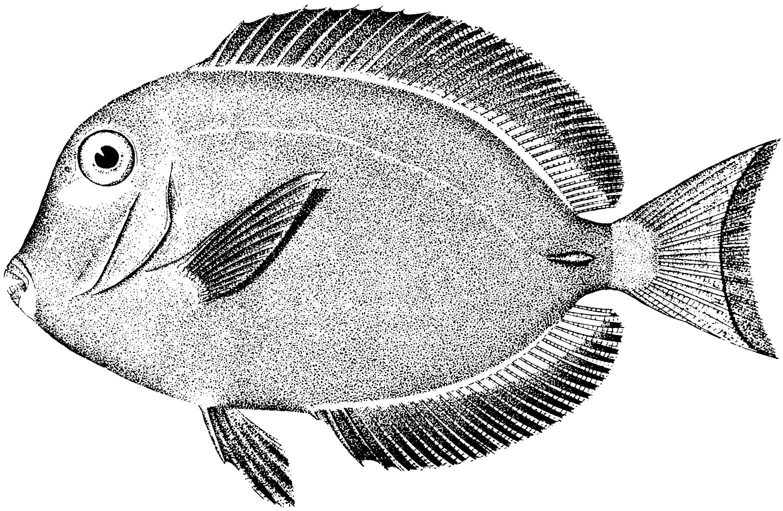

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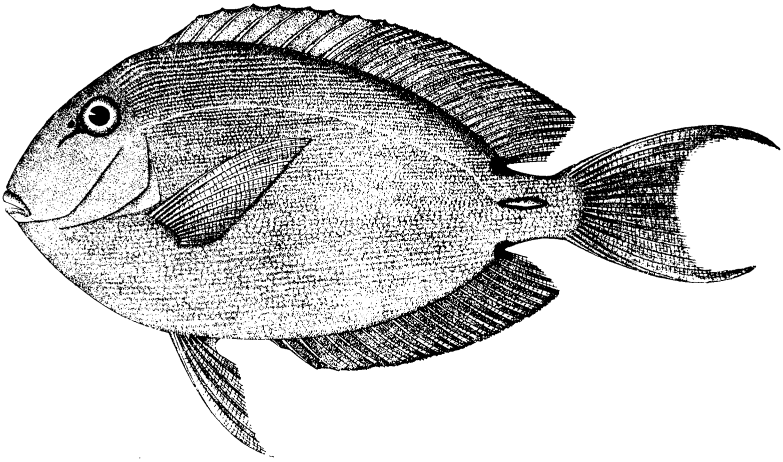

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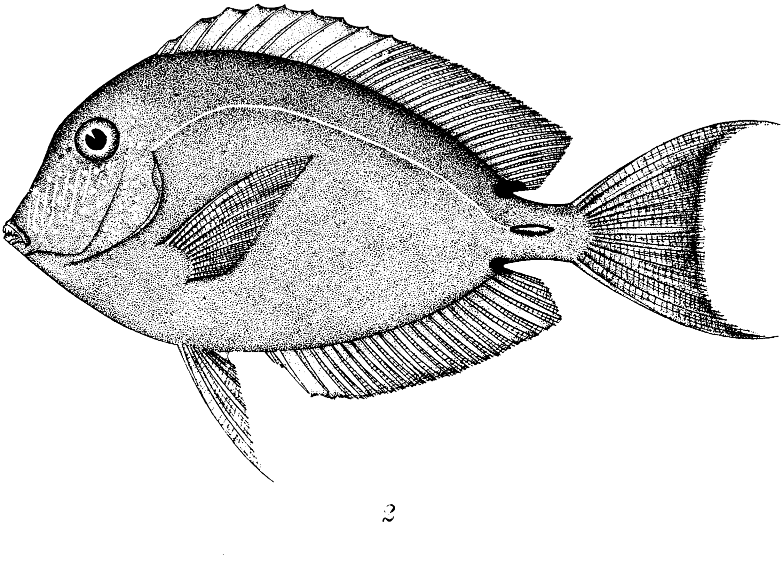

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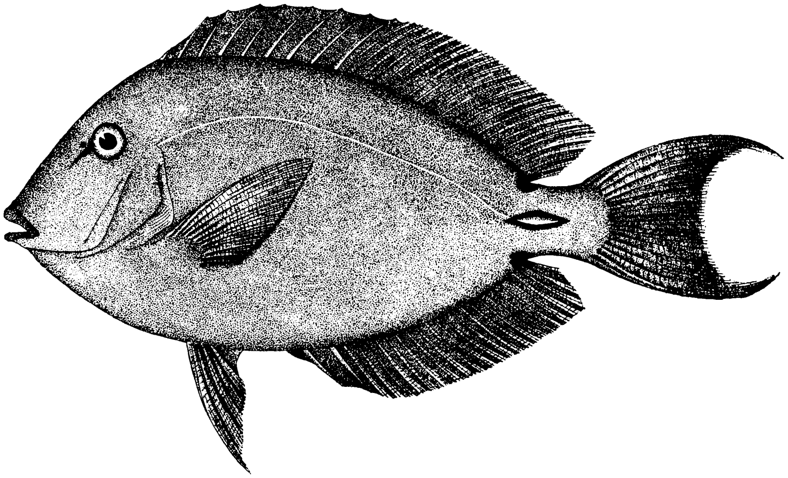

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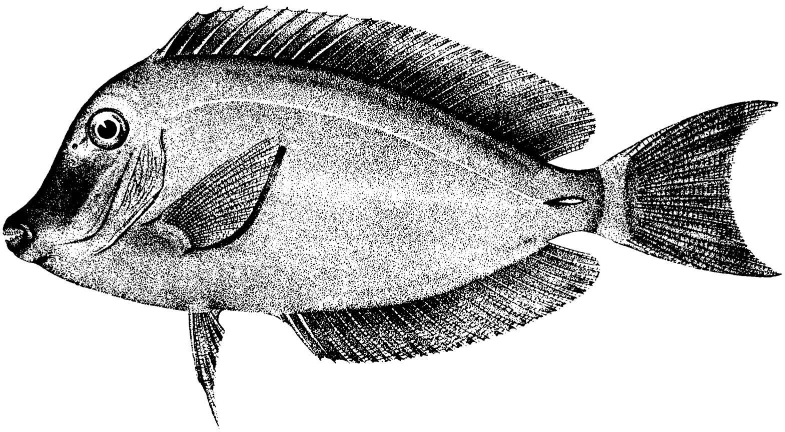

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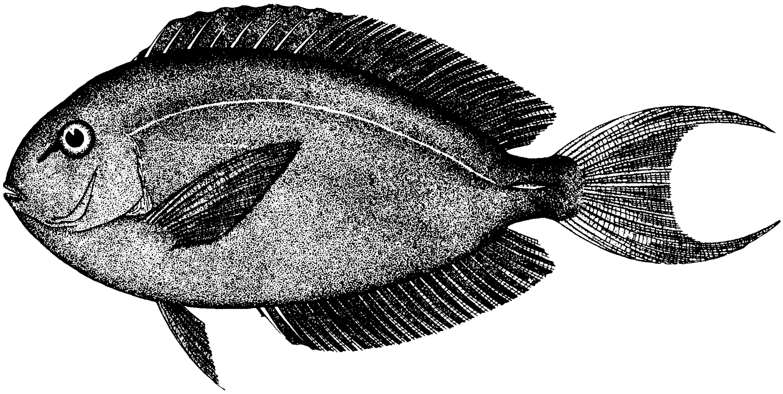

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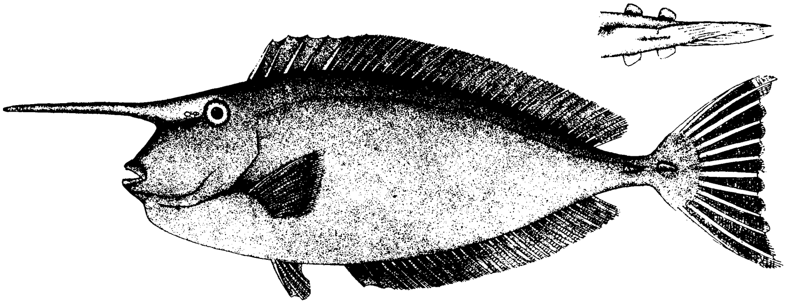

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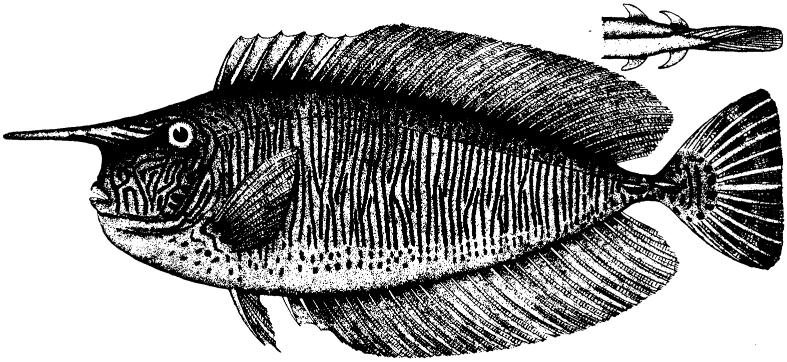

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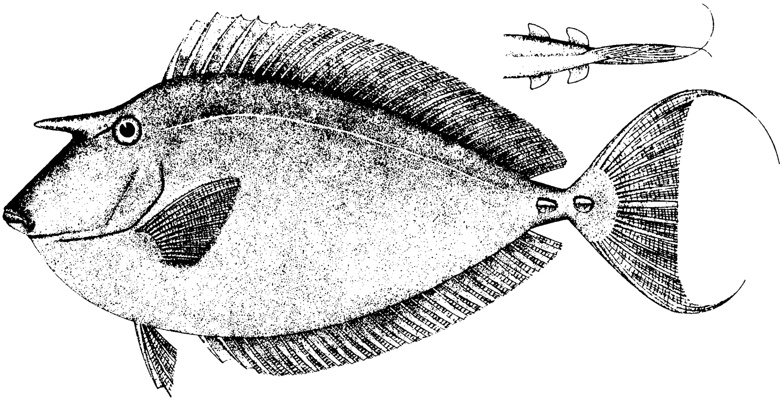

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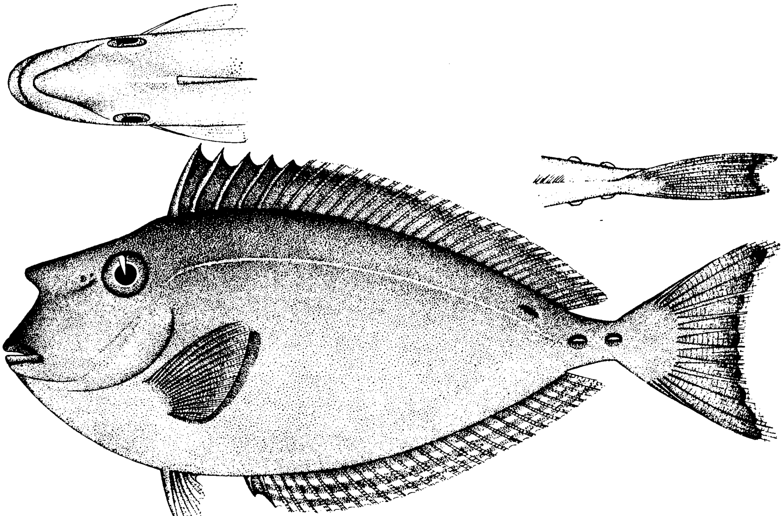

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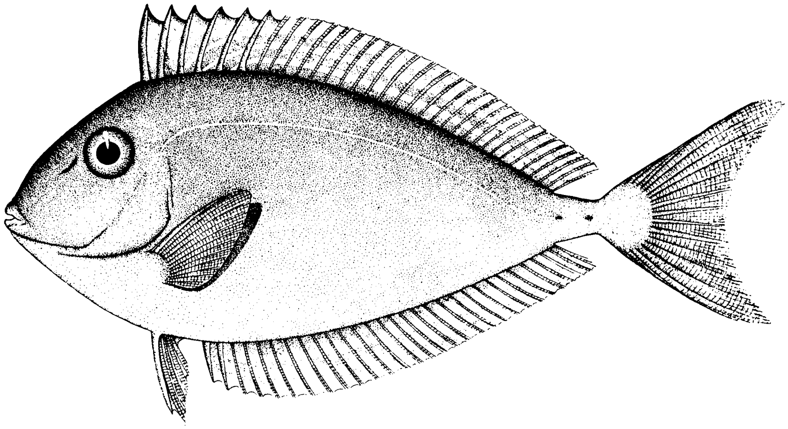

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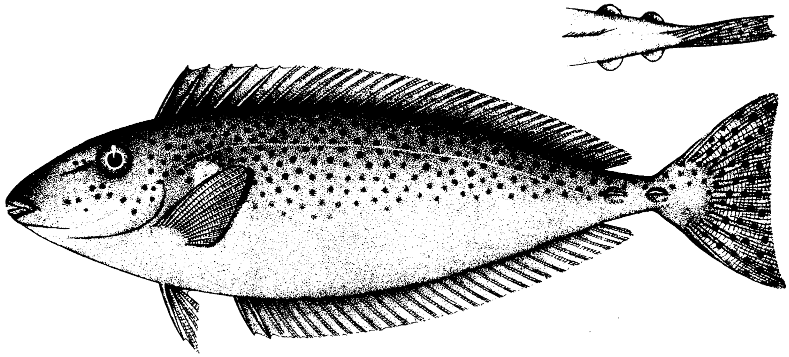

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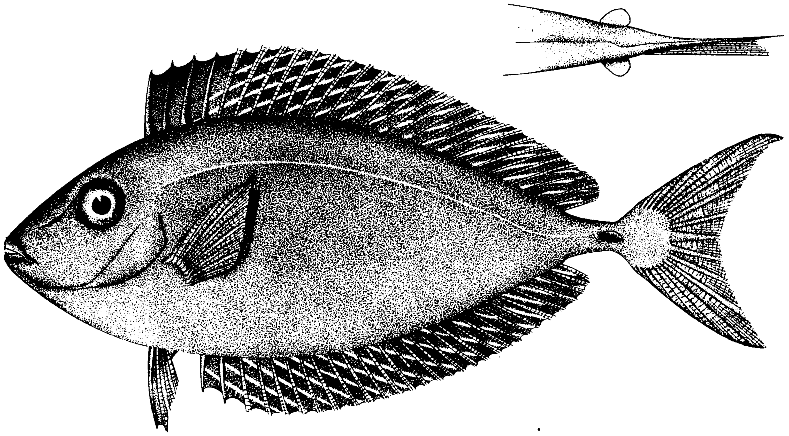

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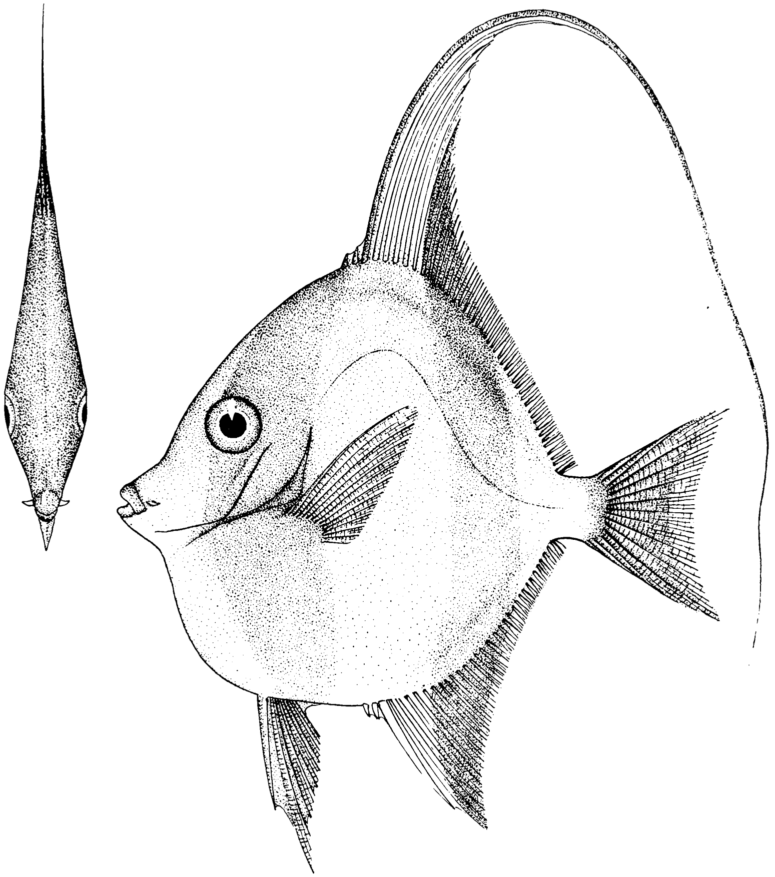

PLATE 8. ZANCLUS CANESCENS (LINNÆUS).

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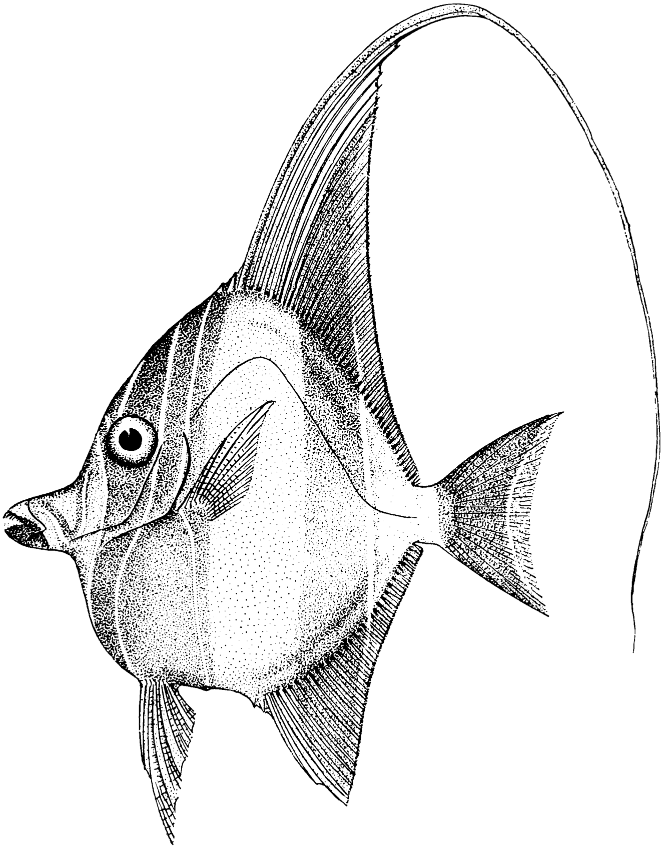

PLATE 9. ZANCLUS CORNUTUS (LINNÆUS).

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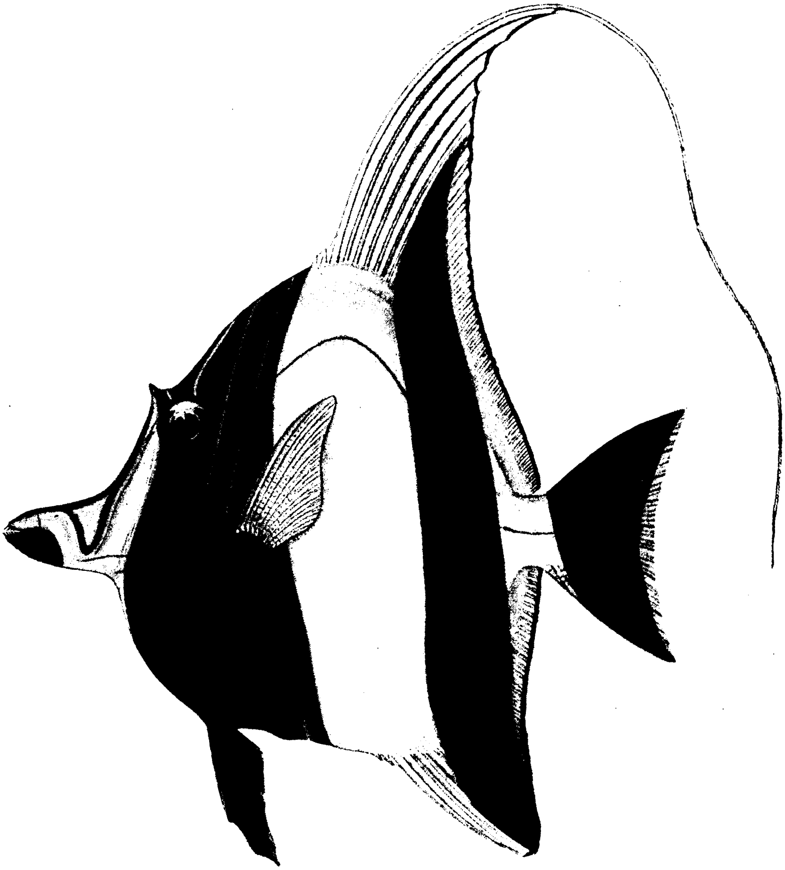

PLATE 10. ZANCLUS CORNUTUS (LINNÆUS).

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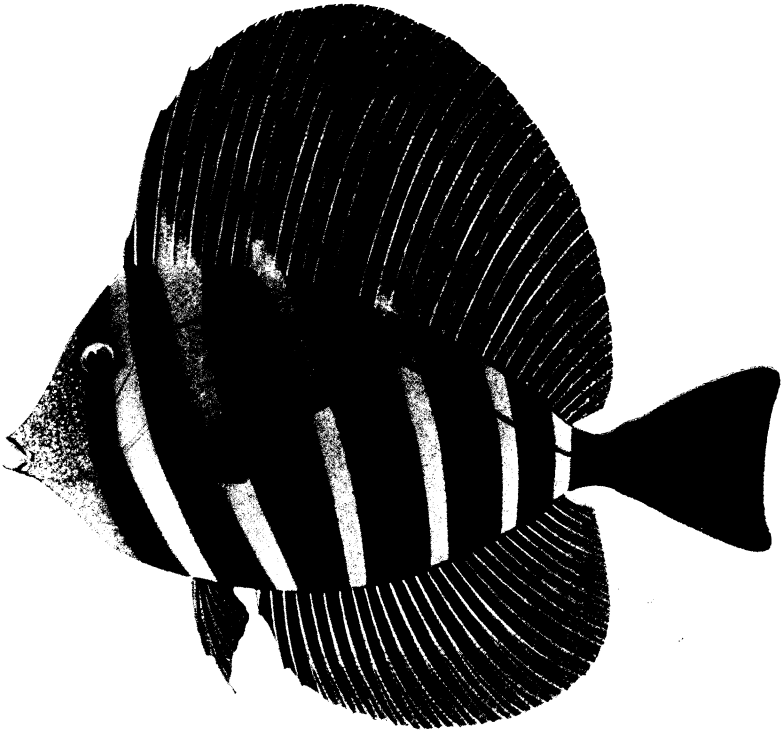

PLATE 11. ZEBRASOMA VILIFERUM (BLOCH).

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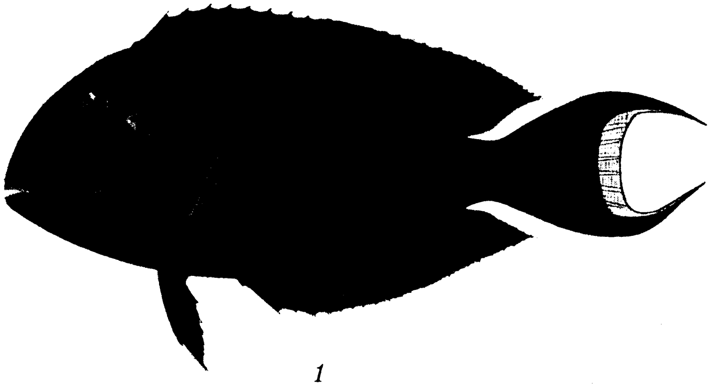

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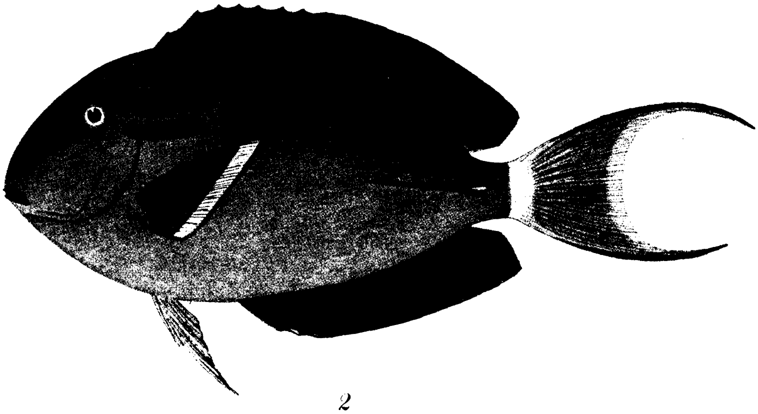

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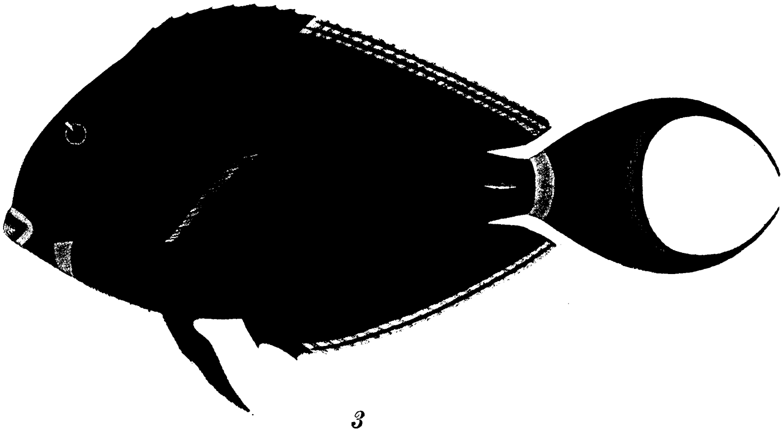

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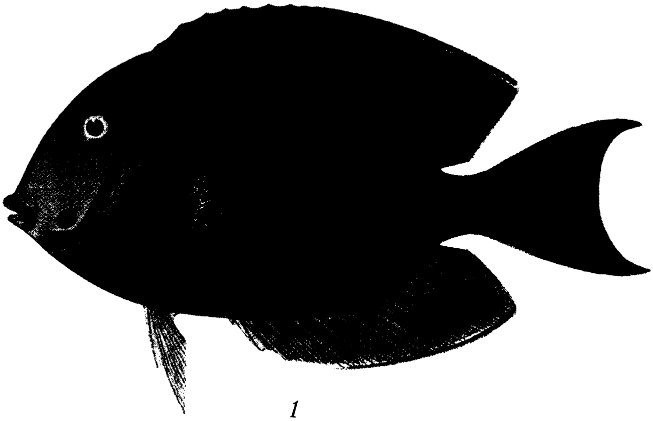

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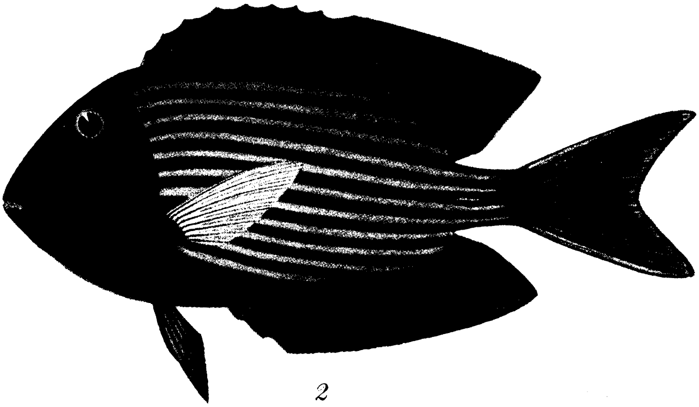

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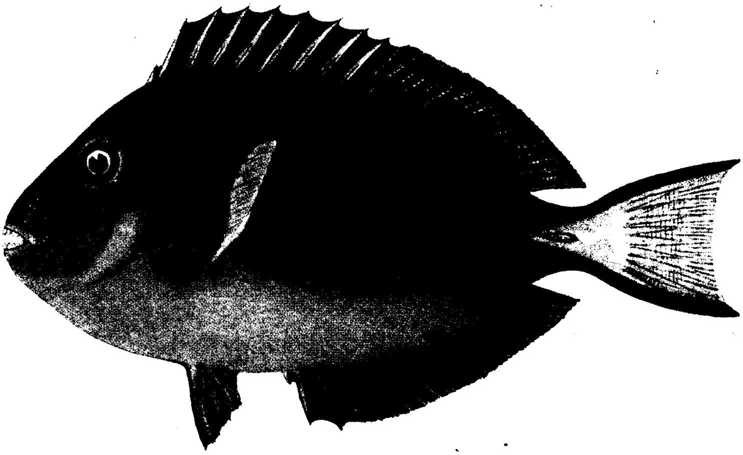

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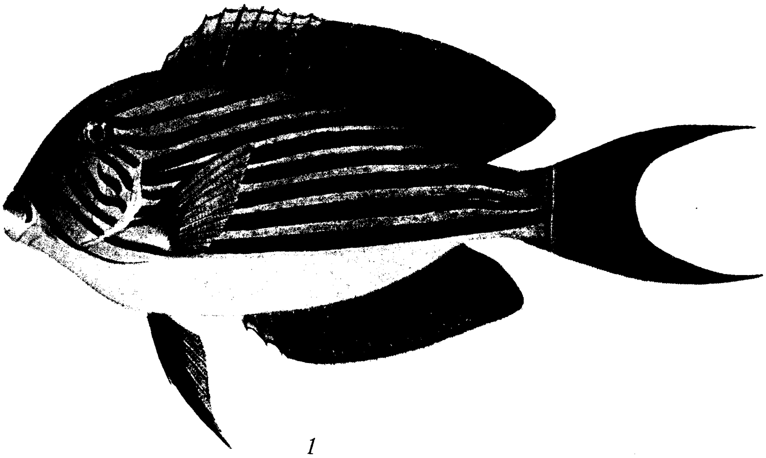

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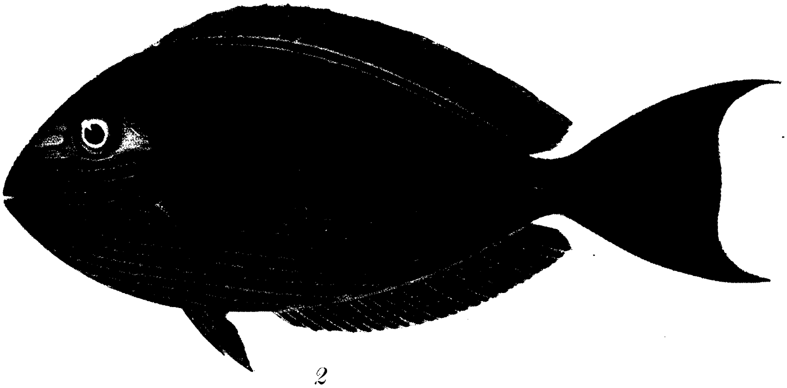

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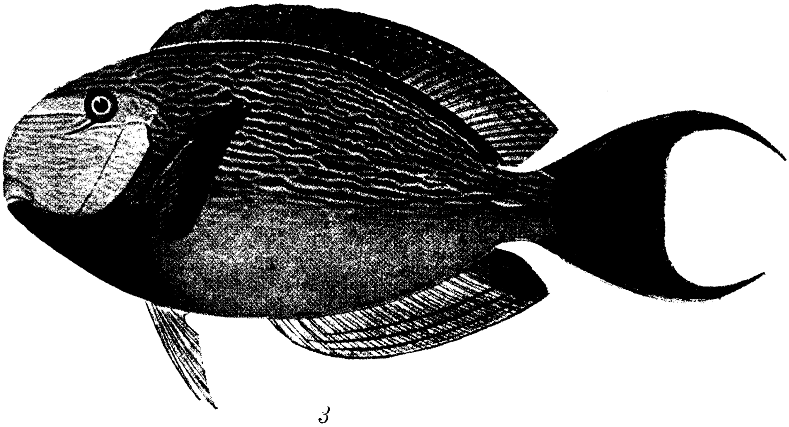

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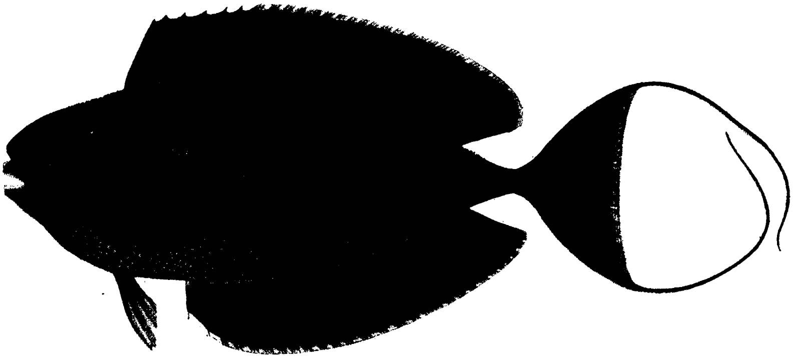

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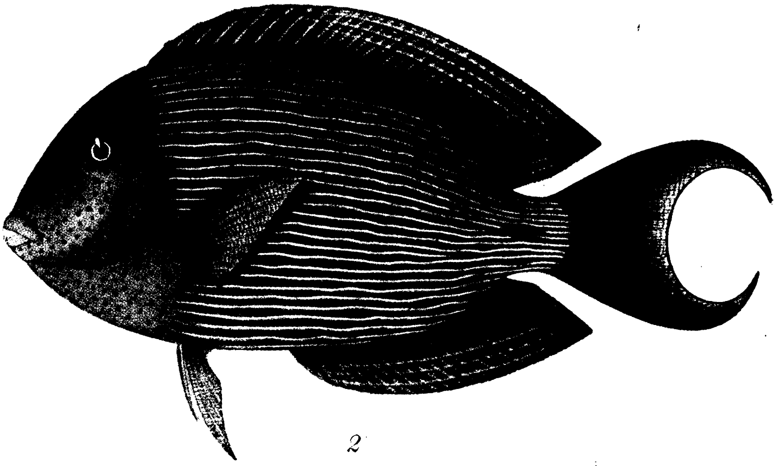

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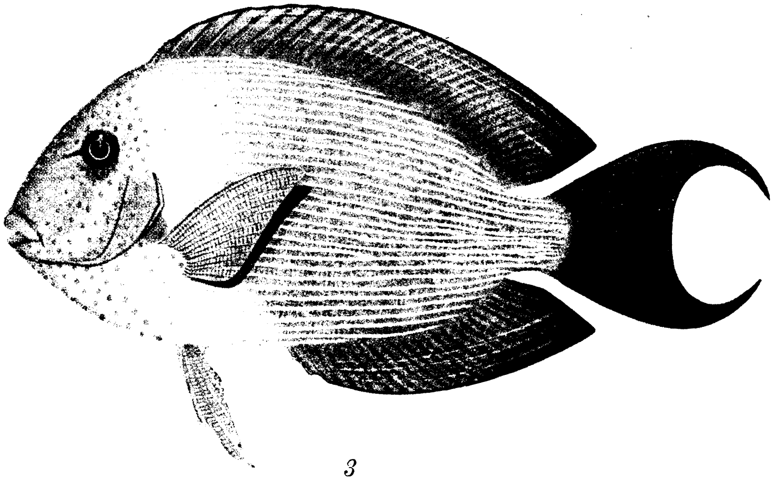

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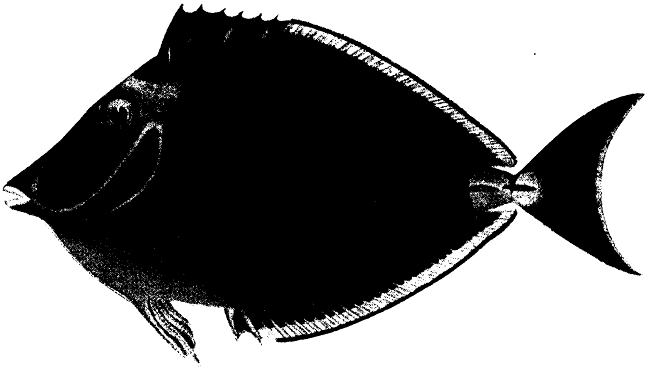

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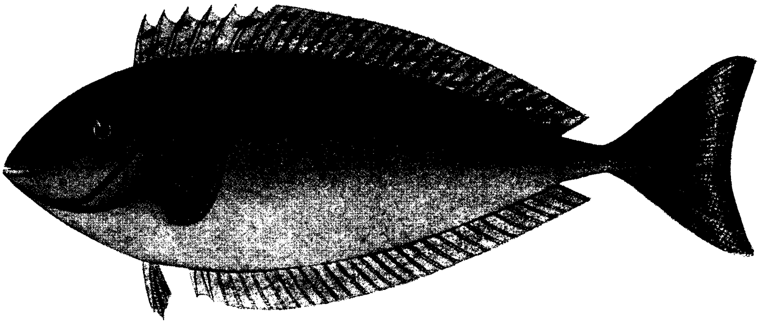

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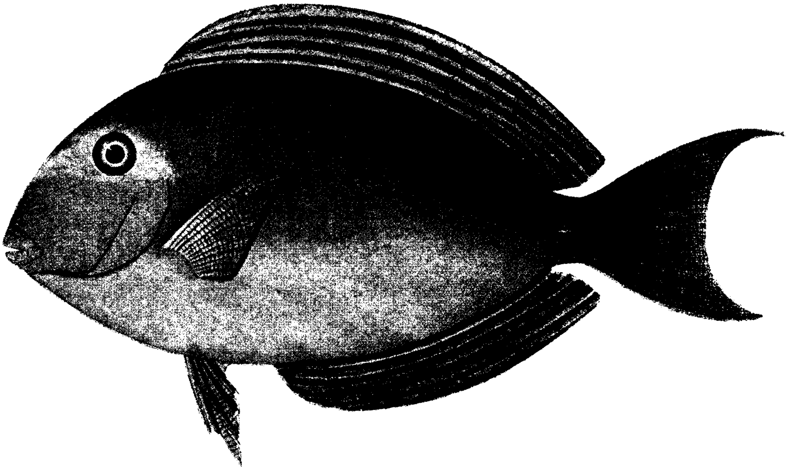

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PLATE 16.

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ERRATA

VOLUME 33

Note.—Dans la description du *Ceratosolen imbecillus* sp. nov., p. 315, j'ai donné erronément l'antenne de la femelle composée de 10 articles, au lieu de 11, et j'ai decrit pour 4^{me} article le 5^{me}. Le 4^{me} article, au contraire, est trés petit mais distinct.

Ceci posé, *C. imbecillus* est presque certainement synonyme de *C. hewitti* Waterst. de l'Ile de Borneo.

(Sgd.) G. GRANDI

VOLUME 34

Page 14, line 14 from bottom, *for* CHELMON BOSTRATUS *read* CHELMON ROSTRATUS.

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